

# An Ecological Survey of the larger Mammals of Peninsular India

BY

M. KRISHNAN

(With fifty-five plates)

(Continued from Vol. 69 (1) : 54)

## THE INDIAN ELEPHANT

*Elephas maximus* (Linnaeus)

(Summary of field notes : Observation records : 241)

*Locations* : Kerala—Periyar Sa. ; Tamil Nadu—Mudumalai Sa. ; Mysore—Bandipur Sa. ; Orissa—Simiipal hills ; Bihar—Palamau N.P., Singhbhum.

Outside peninsular India : West Bengal—Jaldapara Sa. ; Assam—Kaziranga & Manas Sas. ; Uttar Pradesh—East Dehra Dun, Corbett N.P.

*Photographs* : K2, K3, K4, K5, K6, K9, K10, K11, K13, K14, K17, K18, K21, K22, K23, K24, K25, K26, K27, K29, K30, K35, K36, K37, K38, K39, K40, K41 and K43.

TN 5, TN 6, TN 27, TN 28, TN 29, TN 33, TN 38, TN 51, TN 52, TN 56, TN 61 and TN 62.

MY 3, MY 4, MY 5, MY 7, MY 9, MY 10, MY 16, MY 17, MY 19, MY 22, MY 23 and MY 35.

B2, B12, B16, B20 and B21.

MISC 2, MISC 3, MISC 4 and MISC 5).

Although this is the report of an ecological survey, not primarily concerned with habits, behaviour, and external morphology, and although some literature on *Elephas maximus* occurring outside peninsular India is available, it is necessary to provide some account of the habits, behaviour and physical characters of the animal here.

### *Size : Morphological characters*

Old Indian shikar and faunal literature exhibits a tendency surprisingly unusual in it, to be conservative in estimating the height of an elephant. The build of the animal is such that the height at the shoulder is a less reliable indication of size than with most other

animals—the length and circumference of the body, the thickness of the limbs and trunk, and the relative size of the head and body vary so much with individuals that the indigenous system of classifying elephants into the *koomeriah*, *meerga* and *dwasala* types recognises that animals of all three types may be seen in the same herd. In a large herd of over 50 elephants closely observed (and photographed) there was a striking variety of build and conformation noticed (K 60 Apr. 5). When it is possible to follow a herd of elephants and watch them for some time, it is not difficult to distinguish between individual members of the herd by their peculiarities of build.

G. P. Sanderson's much-quoted opinion, 'There is little doubt that there is not an elephant 10 feet at the shoulder in India', was published late in the 19th century. In the section on 'Indian Shooting' by Lt. Col. R. Heber Percy in C. Pillipps-Wolley's compilation, *BIG GAME SHOOTING* (London, 1895), this interesting information is provided: 'The skeleton of the well-known Arcot rogue elephant, now in the Madras Museum, measures 10 ft. 6 ins. at the shoulder. Mr. Rowland Ward considers that when alive it must have stood 10 feet 10 ins.' The mounted skeleton is still at the Government museum in Madras and still measures 10 ft. 6 in., as personally verified.

It is true that a bull elephant over 10 ft. 6 in. high or a cow over 9 feet is so exceptional that it must be left out of consideration in judging adult size, but though I myself have never seen a 10-foot elephant, to fix this as the maximum height attained by a big bull is incorrect. I measured 3 undefaced prints of the forefoot of a big bull in the Manas Sanctuary (Assam) and all 3 gave the height at the shoulder at over 10-foot 2-inch.

Incidentally, it is practically impossible to measure the height of a dead elephant: if the animal subsides on its belly, the feet are bent: if it falls on a flank, the sag of the shoulder is so great that the front leg which is uppermost (naturally, the lower leg cannot be measured) may be extended or retracted: a further complication is that this foreleg in death usually slopes down towards the ground (exceptionally, in *rigor mortis*, the foreleg may remain parallel to the ground, in the corpses of 2 elephants electrocuted by accidental contact with a low-slung high-voltage cable, the upper foreleg jutted out of the body rigidly, well off the ground—MISC 68 May 16). Furthermore, without the weight of the body on the legs, the height cannot be measured reliably: in 2 experiments camp elephants were made to recline on their flanks and keep the foreleg straight out: measurements of the distance between shoulder and sole varied within wide limits and was much in excess of the height of the animal measured when it was standing.

Even with tamed elephants, unless there are necessary facilities for accurately measuring the height when the animal is standing on level ground, measurement of the height of the shoulder may vary within wide limits. For example, the tusker Kali Prasad, stationed at Manas in February 1968, was over 10-foot as high as measured by the Range Officer and only 9-foot 9-inch as measured by me.

Provided the elephant is not malformed or exceptionally short-legged, the rule that twice the circumference of the forefoot will give the height at the shoulder within an inch or so is quite reliable with adult elephants. This is the *only* way to know the height of a wild elephant. Here, again, care and accuracy in measuring the circumference are essential for reliability. It is the clear, undefaced print of the forefoot that must be measured (as where the animal has turned sharply) and it is often said that this print must be on hard dry ground and not on moist soil, because in soft soil the foot-print tends to splay. It does not. The sole of an elephant's foot does not splay in the manner of the pug of a tiger or even the slots of a sambar on wet soil. Of course in loose sand, the imprint is not clear and the sand pushed out at the periphery leads to errors, and in mire (when the foot is pulled out of the mire at each step) there is never a clean imprint, but it is on moist earth, as on the edges of paddy fields or on bare ground after a rain, that the clearest imprints will be found. I have measured the forefoot print of the same elephant on such moist ground and also on firm ground a few yards away, and it was the print on hard dry ground that gave a circumference greater by an inch: this is because with slightly yielding soil it is not only the cushioned sole of the animal that gives beneath its great weight. The method used by me is to lay a thin, non-stretchable cord, inch by inch, along the inner line marking the circumference, with no sag in the cord: small sharp slivers of wood driven vertically into the periphery of the footprint help in this. The total length of the cord marking the circumference, is then measured. With care this method gives unvarying measurements. The diameter should not be measured for two reasons: first, the forefoot imprint of the elephant is not perfectly circular and therefore the circumference cannot be calculated by multiplying the diameter by  $3\frac{1}{7}$ ; second, even small errors become material in such a calculation for by the time the height of the elephant is computed the diameter, and therefore the error, has been multiplied  $6\frac{2}{7}$  times.

As already said, height is only one dimension in assessing size in an elephant. The length of the body varies considerably, especially in big bulls, as also its thickness. A massive bull fully 6 inches shorter than a leggy, thin animal may easily defeat the latter in a fight.

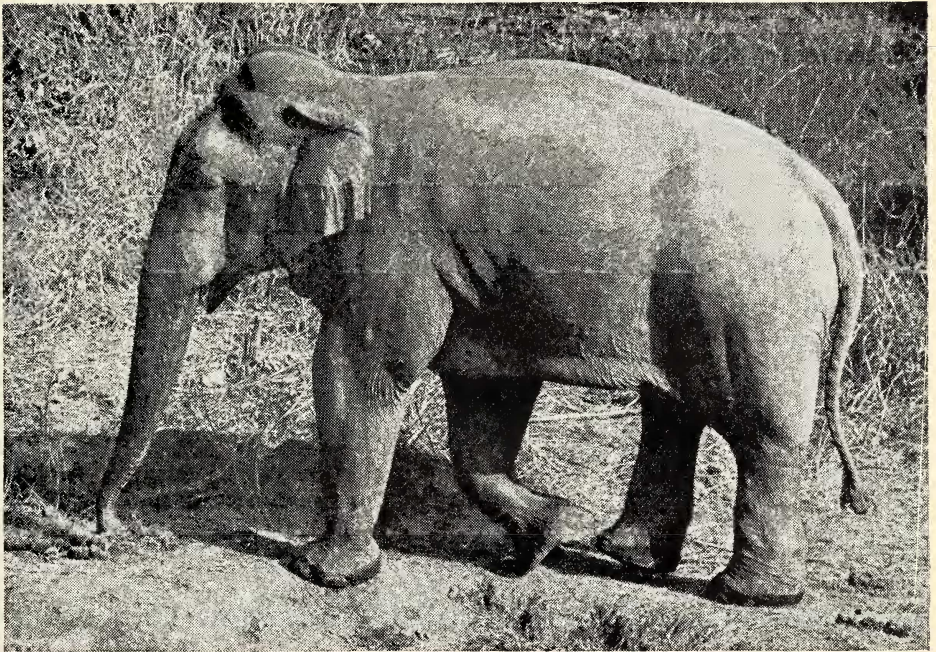
Length of tusks, in adult bulls, especially in old bulls, convey no idea whatever of size. The biggest tusks are carried by bulls whose tusks slope down to the ground, and these are generally thin. Nor does the mere thickness of the tusks reflect size or power, though an animal with horizontally carried thick tusks, especially when these project about 3 feet from the gums and are evenly curved, is usually stout, long-barrelled and powerful (photographs K2, K5 and K6); very long tusks, such as the 'record tusks' cited in the literature on elephants, are no indication of the bull carrying them being of exceptional size: on the contrary, such animals are usually only of average size. Such tusks are a constant embarrassment to their owner, hindering free movement (especially of the head and trunk) and being a serious handicap in intraspecific fights, sometimes even in feeding. Thin, sharp-pointed, curved tusks are murderous weapons in intraspecific combats (photograph MISC 2, TN 61).

Mucknas may be found all over the range of the elephant in India and are not regional features; for instance they occur in Kerala, Tamil Nadu, Mysore, Orissa, Bihar, West Bengal and Assam. However, they are commoner in Assam and Bihar than in the southern States of India (TN 59 Mar. 5, 66 Apr. 5; MISC 68 Feb. 10; B 69 Feb. 19, 23). Tuskers have one or both tusks frequently broken accidentally or in intraspecific combats (B 68 Apr. 24—photograph B2; MY 68 Oct. 9). Sometimes an entire tusk may be lost, usually in a fight, and then the bull has only one tusk visible and is termed a 'Ganesha' (TN 63 Sep. 20, 70 Sep. 23). The camp elephant Caesar which was stationed at the Mudumalai Sanctuary for many years (till his death) had a tusk wrenched away in an engagement with a wild tusker. Cows, even when adult or old, frequently carry short tusks, projecting a few inches from the lips—these are called 'scrivelloes' in the ivory trade in India. There seems to be no regional bias to the possession of tusks by cows, and it is much commoner than is generally realised (K 70 Apr. 23).

Weight is a much more reliable indication of size in an elephant than measurements, but naturally it is very seldom possible to weigh such a huge beast and there are few reliable records. The weight of tamed elephants is no guide, for it is seldom that an elephant in captivity attains the mass and musculature of wild elephants. A very big bull may probably weigh between 4 and 5 tons. The height of a newborn calf varies from about 30 inches to 36 inches and its weight is around 200 lb.

The colour of an adult elephant is largely a question of the colour of its skin, for when full-grown the hair on the body is too sparse to influence colour. Some animals have a lighter coloured skin and some much darker skin: in the lighter grey animals there is often

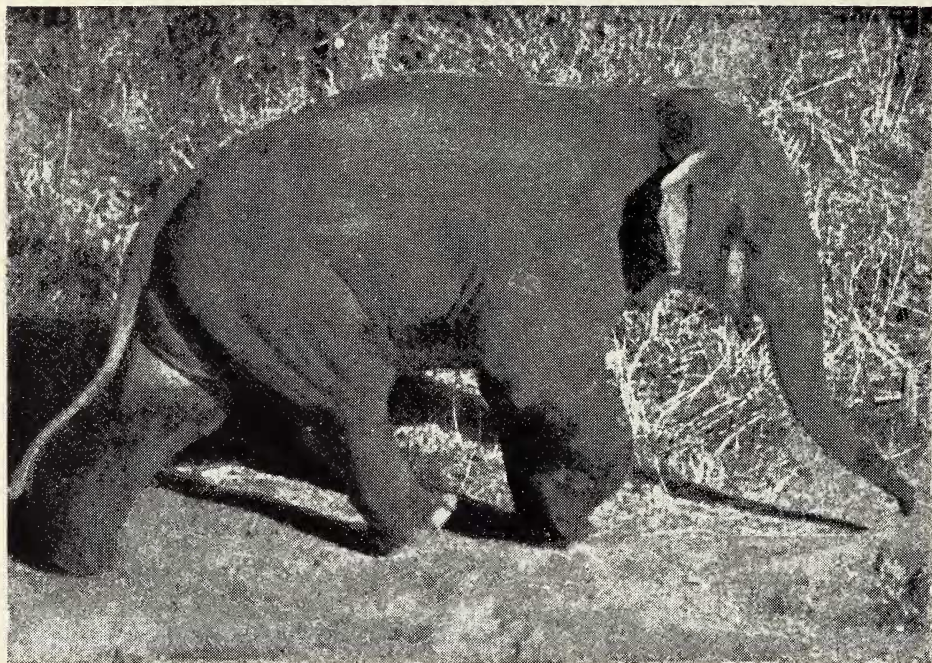
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*Above* : BIHAR 1968 : BARESAND SA. : April 24 — a.m. : The bull with the broken tusks — B. 2 ; *Below* : BIHAR 1969 : BETLA : PALAMAU : February 19 — About 3.15 p.m. : The big cow, at Hathbajhwa — B. 12.

(Photos : M. Krishnan)

Krishnan : Mammals



*Above* : BIHAR 1969 : BETLA : PALAMAU : February 23 — About 4.30 p.m. : The larger muckna going flat out, chasing the smaller. Note musth stain on cheek — B. 16 ; *Below* : BIHAR 1969 : BETLA : PALAMAU : February 26 — p.m. : Young calf staging a sit-down strike — B. 20.

(Photos: M. Krishnan)

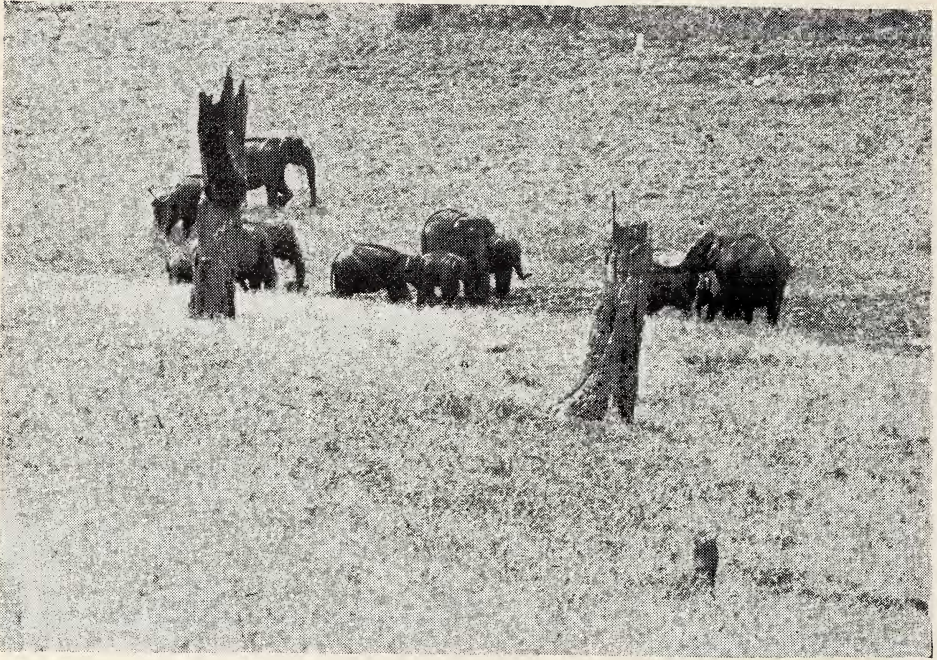
Krishnan : Mammals



*Above* : BIHAR 1969 : BETLA : PALAMAU : February 26 — p.m. : Subadult elephants at play at the pool at Hathbajhwa — B. 21 ; *Below* : PERIYAR SA. : KERALA : May 20, 1959, a.m. : Tusker with tusks over 3-foot long — the presumed winner of the fight. Note raised weal above thigh — a tusk-wound — K. 2.

(Photos : M. Krishnan)

Krishnan : Mammals

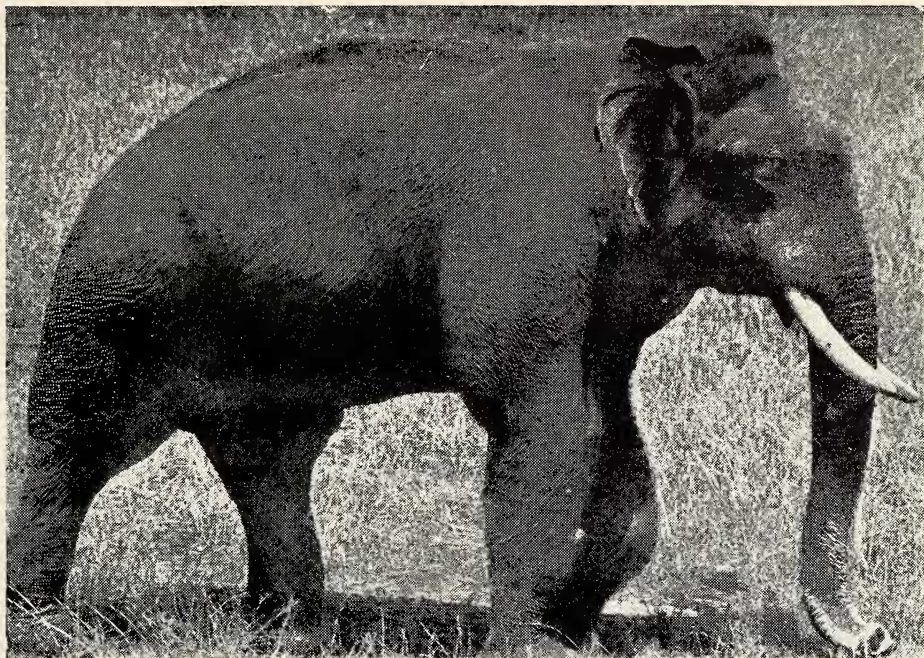


*Above* : KERALA 1969 : PERIYAR SA. : April 3 — p.m. : Herd of 12 elephants at an inland pool — K. 3 ; *Below* : KERALA 1960 : PERIYAR SA. : April 4 — a.m. : Herd of elephants grazing on a hill, near Koyyathotti — K. 4.

(Photos : M. Krishnan)



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*Above* : KERALA 1960 : PERIYAR SA. : April 10 — a.m. : A perfect koomeriah. 9' 10" as per forefoot imprint : in musth — K. 5 ; *Below* : KERALA 1960 : PERIYAR SA. : April 10 — a.m. : Same lone tusker as in previous picture laving his swollen musth-glands. Note adherent clay on tusk and wounds on legs and trunk — K. 6.

(Photos : M. Krishnan)

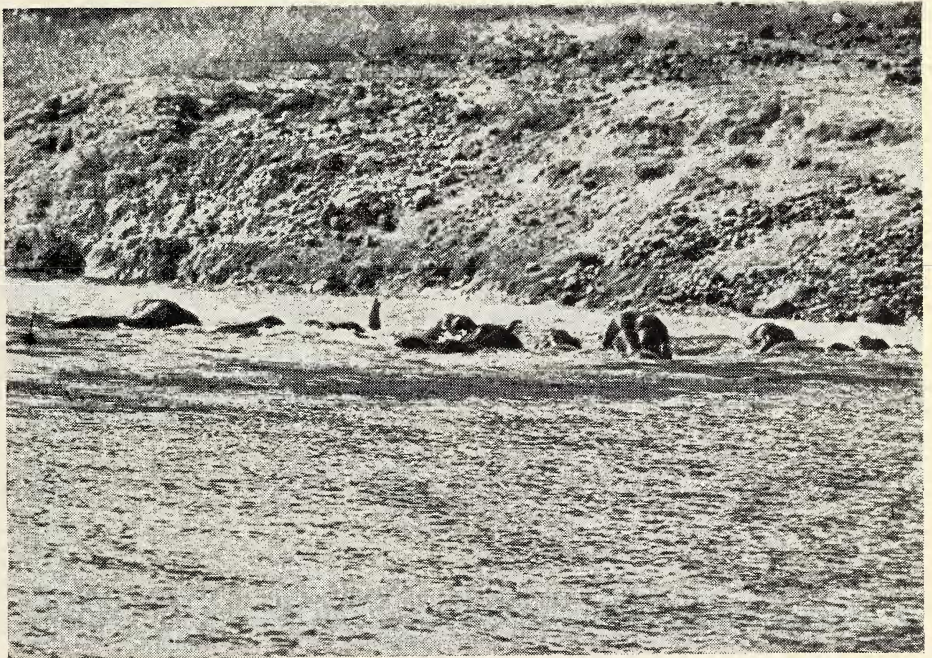
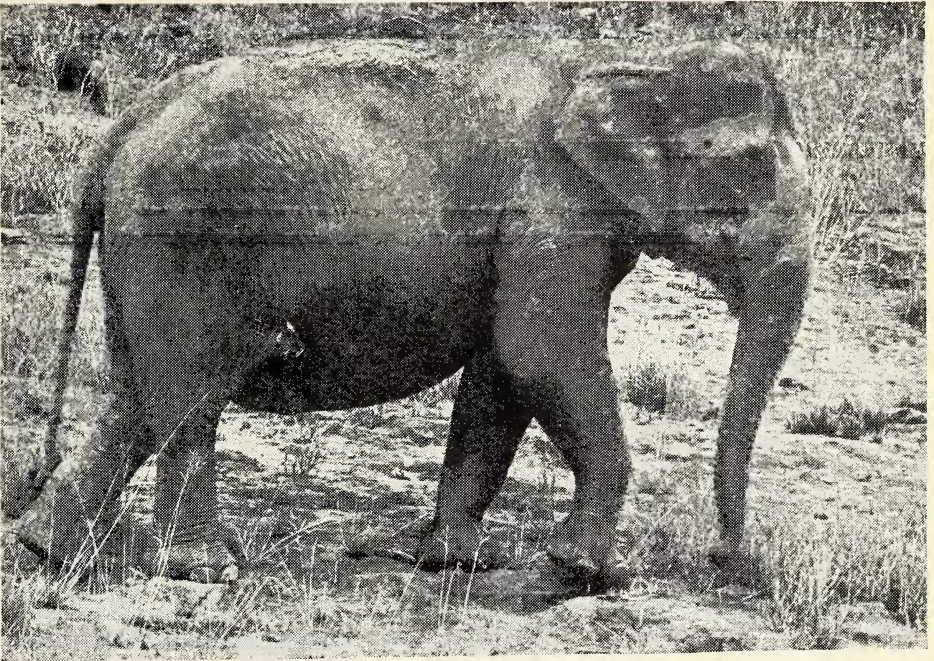
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*Above* : KERALA 1970 : PERIYAR SA. : April 20 — a.m. : The 'conference' breaking up — K. 9 ; *Below* : KERALA 1970 : PERIYAR SA. : April 22 — p.m. : Cow elephant dusting herself after a swim. Note lacing of pink to edge of ear in 2 cows — K. 10.

(Photos : M. Krishnan)

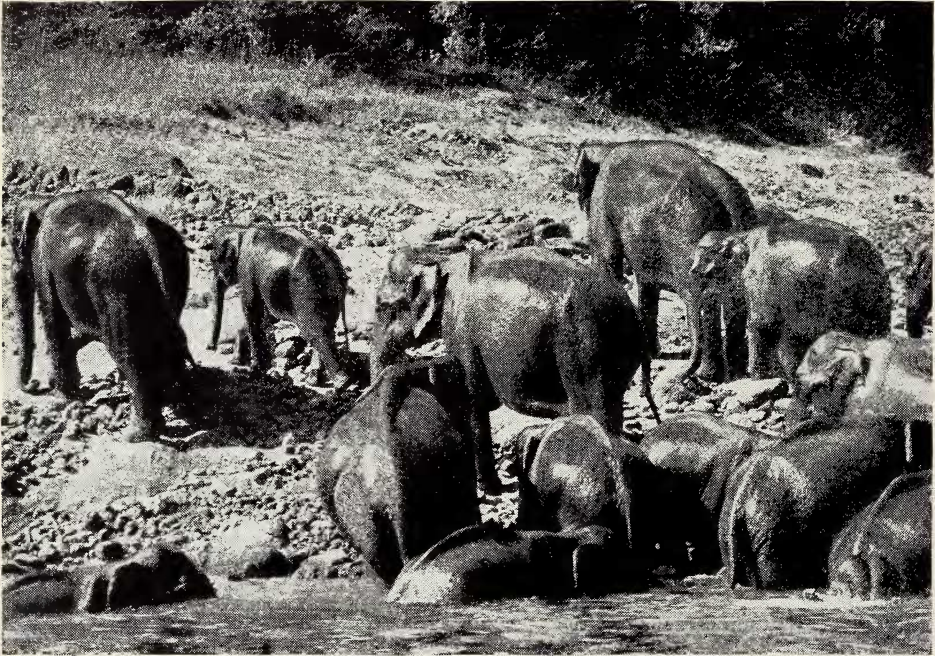
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*Above* : KERALA 1970 : PERIYAR SA. : April 22 — p.m. : Pregnant cow in musth (note black spot around pore of musth-gland — other pix of this cow show a similar spot on the left side, too) — K. 11 ; *Below* : KERALA 1970 : PERIYAR SA. : April 23 — a.m. : Elephants swimming across the Periyar. Note the landing, to the right, for which they are making — K. 13.

(Photos : M. Krishnan)

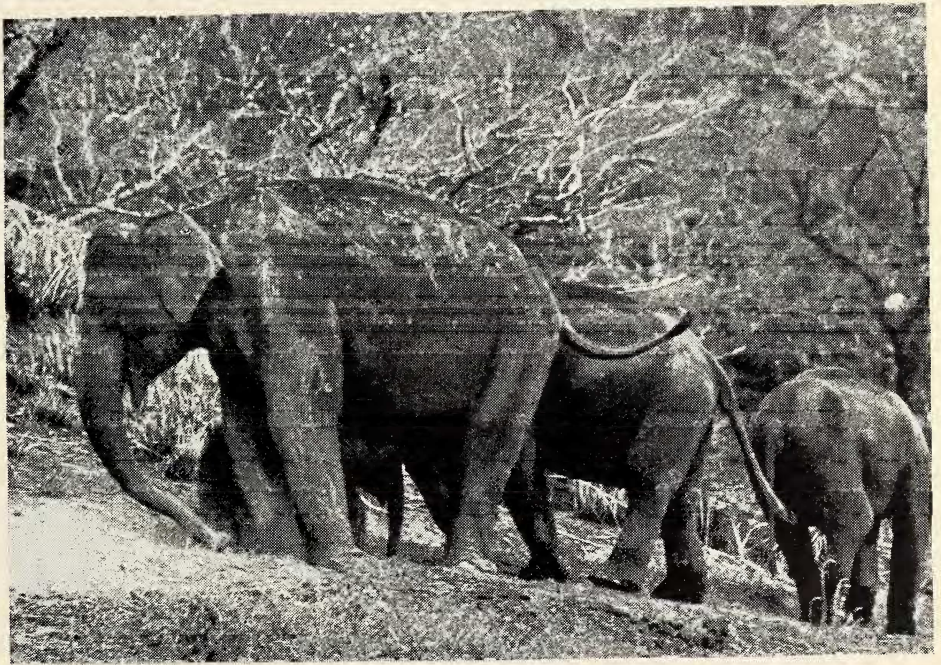
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*Above* : KERALA 1970 : PERIYAR SA. : April 23 — a.m. : Elephants climbing ashore after the swim (see previous picture). Note border of pink to the ear of the central cow — K. 14; *Below* : KERALA 1970 : PERIYAR SA. : April 29 — a.m. : Elephants swimming across the Periyar — side view — K. 17.

(Photos : M. Krishnan)

Krishnan : Mammals



*Above* : KERALA 1970 : PERIYAR SA. : April 29 — a.m. : The same party shown swimming in the previous picture climbing ashore. Note gradual slope of landing — κ. 18 ;  
*Below* : KERALA 1970 : PERIYAR SA. : April 30 — a.m. : Cow scraping and eating salt-earth — note the encumbering calf — κ. 21.

(Photos : M. Krishnan)

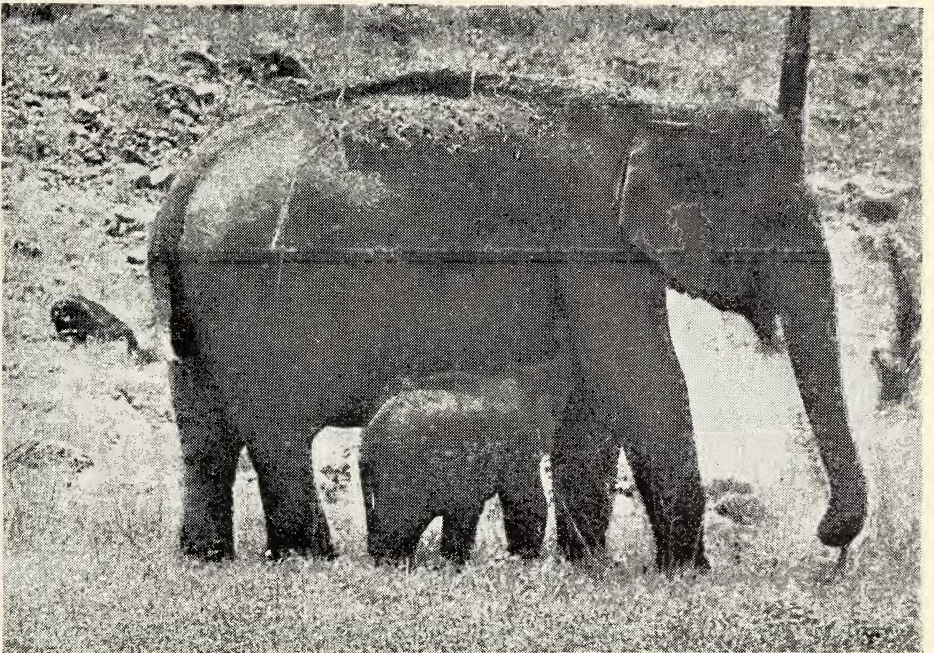
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*Above* : KERALA 1970 : PERIYAR SA. : May 1 — a.m. : Cow smelling me — the elephants following her left the path and went away — K. 22 ; *Below* : KERALA 1970 : PERIYAR SA. : MAY 1 — a.m. : A calf, lying down in its mother's path, being hoisted to its legs — K. 23.

(Photos : M. Krishnan)

Krishnan : Mammals



*Above* : KERALA 1970 : PERIYAR SA. : May 1 — a.m. : Calf in previous picture waiting for its mother after a spell of play with another calf — K. 24 ; *Below* : KERALA 1970 : PERIYAR SA. : May 1 — a.m. : A big cow suckling her calf — K. 25.

(Photos : M. Krishnan)

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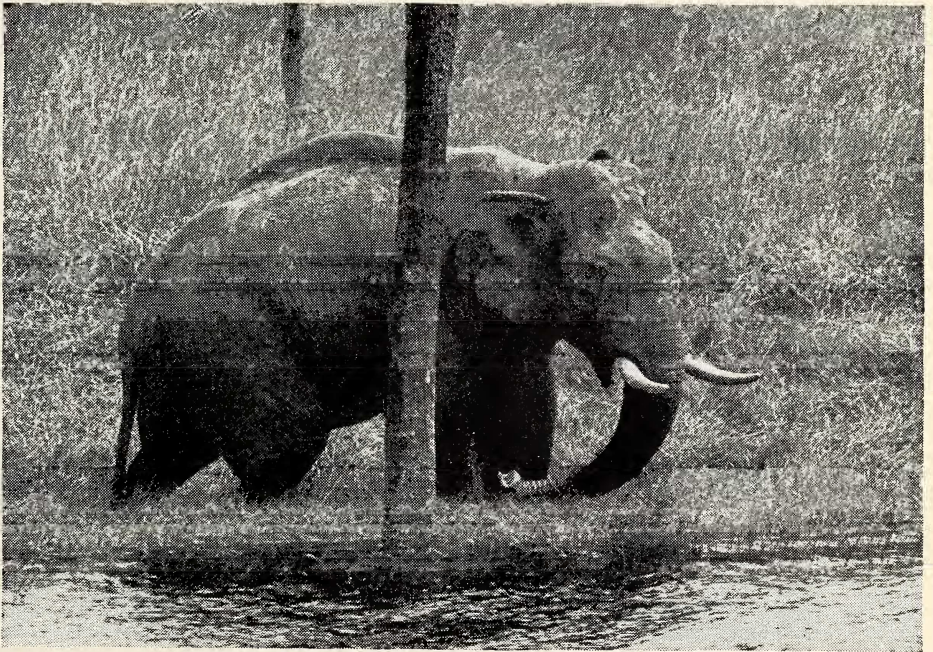


*Above* : KERALA 1970 : PERIYAR SA. : May 2 — a.m. : Calves playing in the water — K. 26 ; *Below* : KERALA 1970 : PERIYAR SA. : May 3 — a.m. : Typical attitude of a cow panicking — K. 27.

(Photos : M. Krishnan)



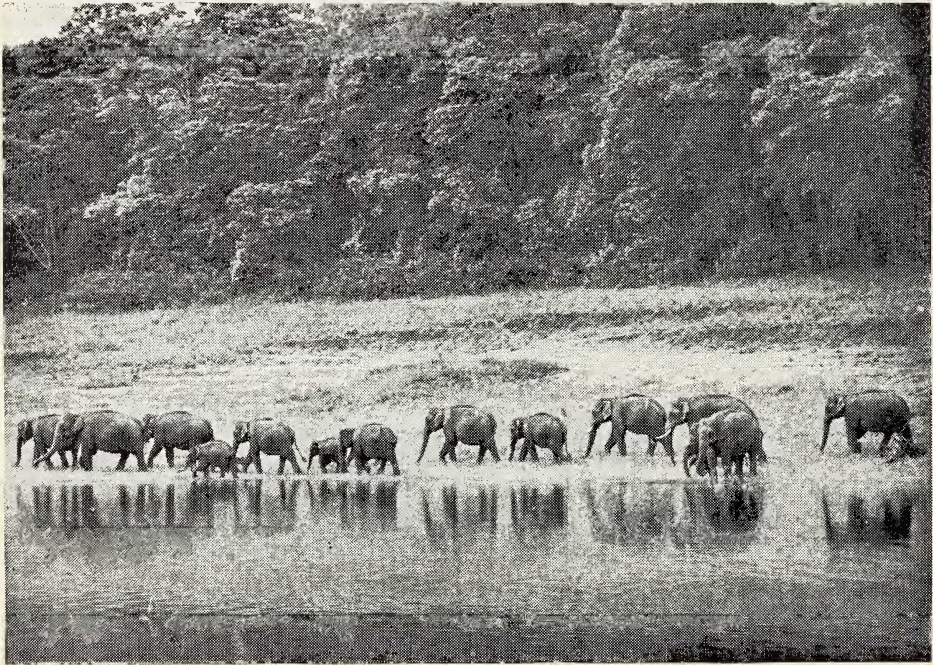
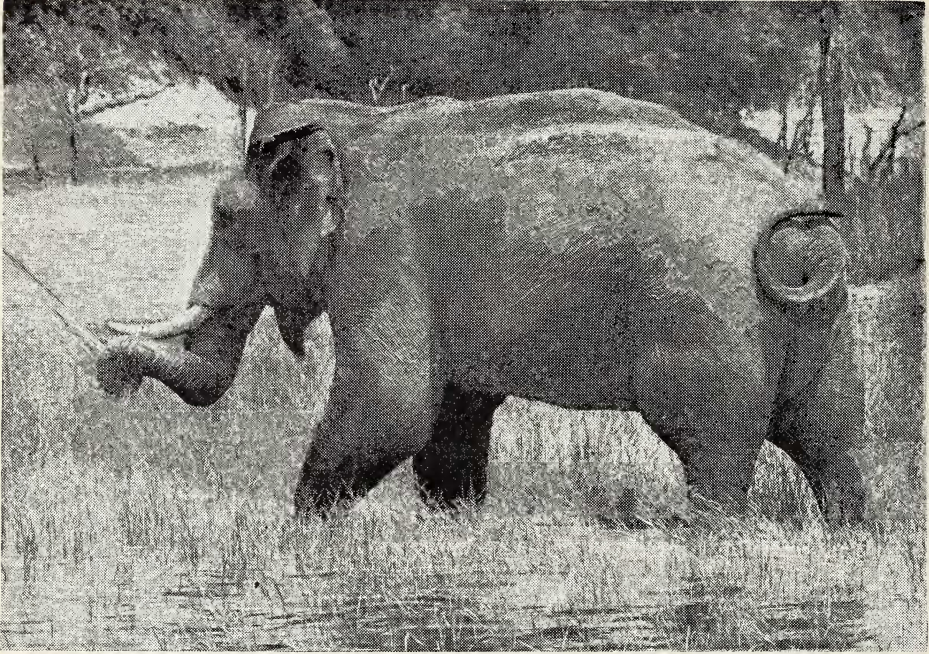
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*Above* : KERALA 1970 : PERIYAR SA. : May 6 — a.m. : Lone tusker at Aruvi dusting grass against his knee — κ. 29 ; *Below* : KERALA 1970 : PERIYAR SA. : May 6 — p.m. : The lone tusker on the island. He was not rubbing himself against the deadwood, but turning sharply past to get near the boat — κ. 30.

(Photos : M. Krishnan)

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*Above* : KERALA 1970 : PERIYAR SA. : May 8 — a.m. : Lone tusker feeding on submerged grass and sedge — K. 35 ; *Below* : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 16 elephants in the bay behind the rest-house — K. 36.

(Photos : M. Krishnan)

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*Above* : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay : Cow having a wallow — K. 37 ; *Below* : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay. Young tusker rubbing himself against tree. Note turgid, outwardly-directed breast of cow — K. 38.

(Photos : M. Krishnan)

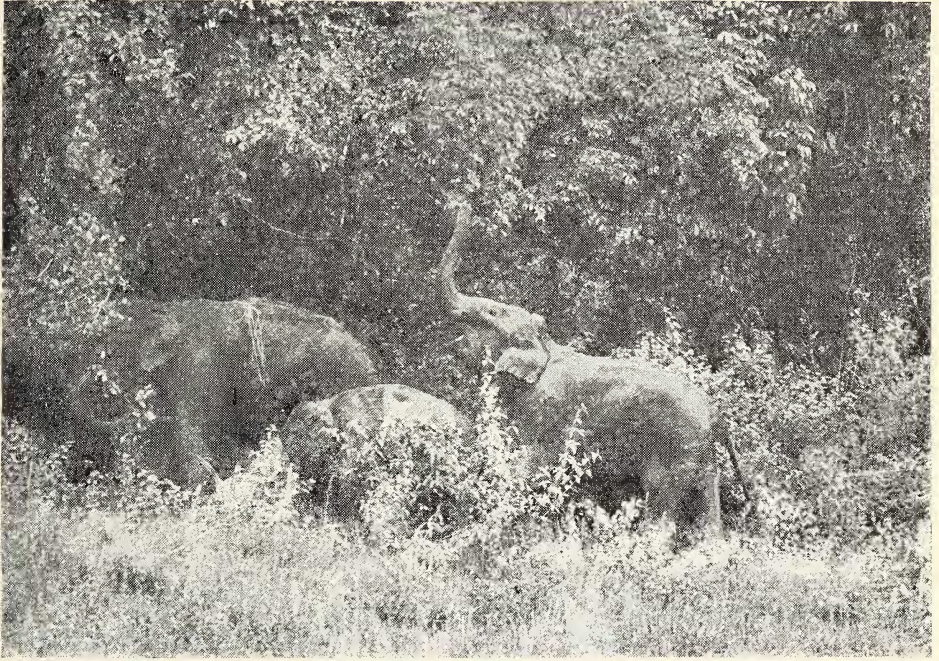
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*Above* : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay. Grown cow crossing the log — K. 39 ; *Below* : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay. Calf attempting to get over the log : Note cow leading young round obstacle — K. 40.

(Photos : M. Krishnan)

Krishnan : Mammals



*Above* : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants : Cow feeding on tree foliage — K. 41 ; *Below* : KERALA 1970 : PERIYAR SA. : May 10 — p.m. : Cow and calf scenting us — K. 43.

(Photos: M. Krishnan)

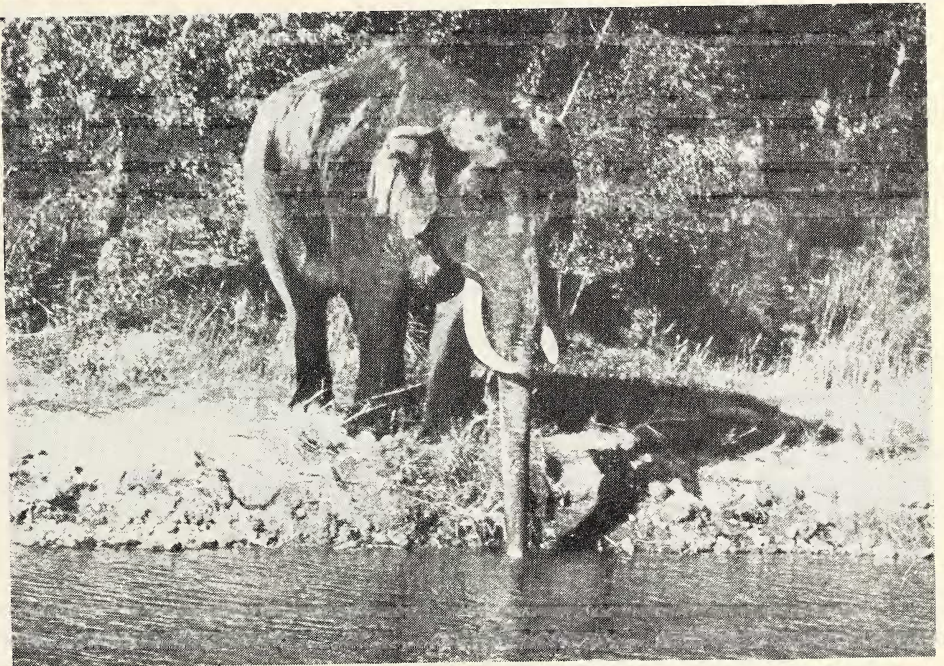
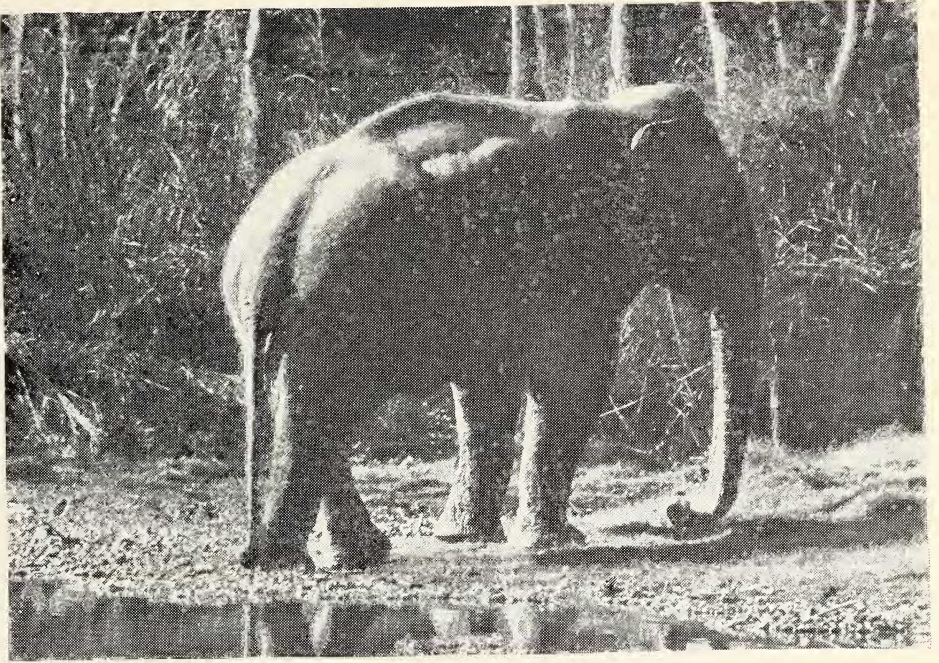
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*Above* : MISCELLANEOUS : Jaldapara, WEST BENGAL : 1965 October 22 — a.m. : The Killer of Shibji — MISC. 2 ; *Below* : MISCELLANEOUS : Kaziranga, ASSAM : 1965 February 4 — p.m. : Tusker eating water hyacinth at Bimoli bheel — MISC. 3.

(Photos : M. Krishnan)

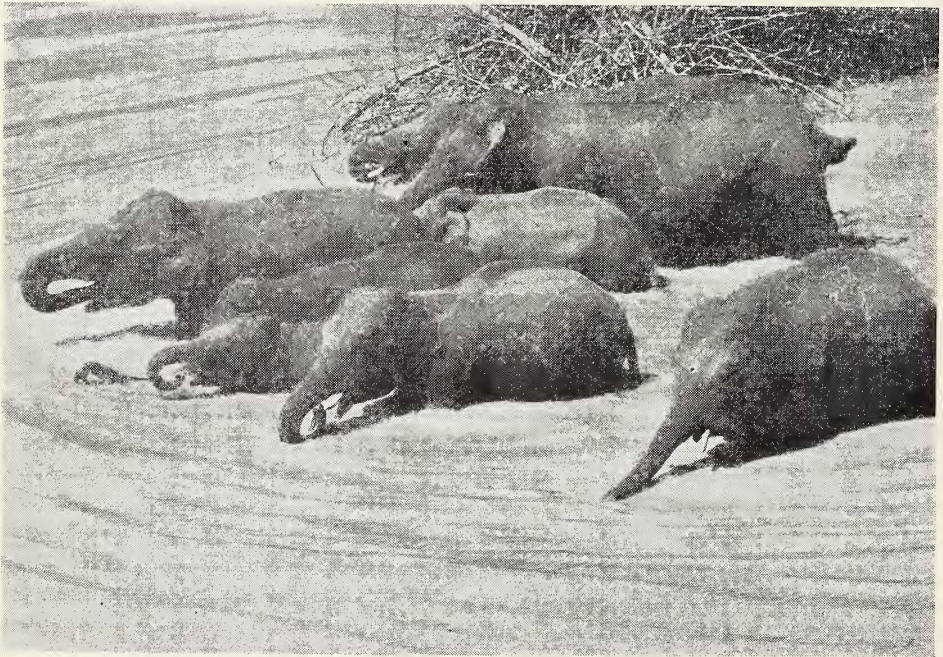
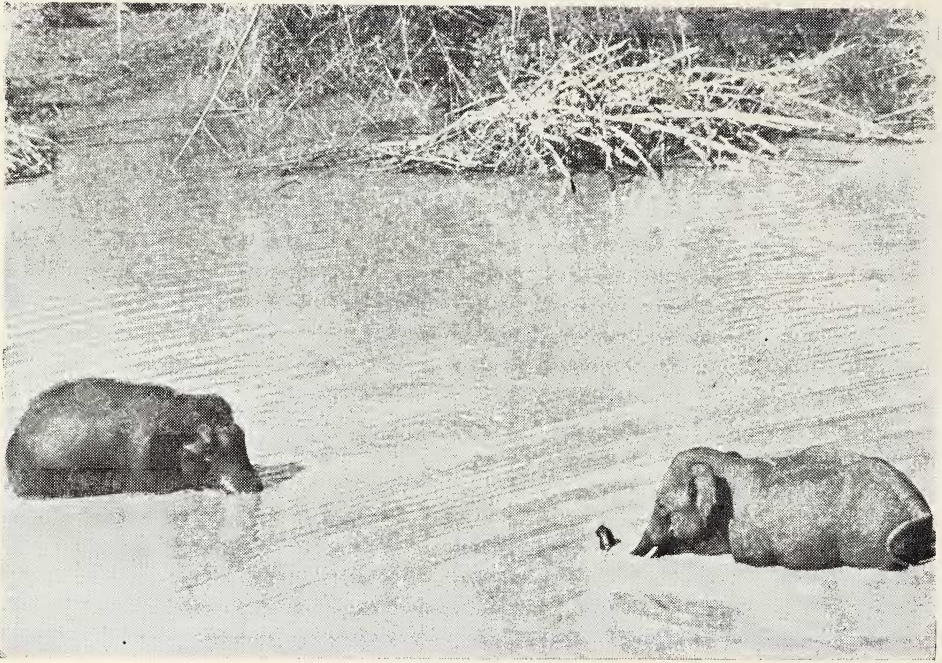
Krishnan : Mammals



*Above* : MISCELLANEOUS : Kaziranga, ASSAM : 1968 February 10 — p.m. : The muckna at Bokani bheel — MISC. 4 ; *Below* : MISCELLANEOUS : Corbett National Park, UTTAR PRADESH : 1968 May 18 — p.m. : Tusker drinking at the Ramganga : Note extensile trunk — MISC. 5.

(Photos : M. Krishnan)

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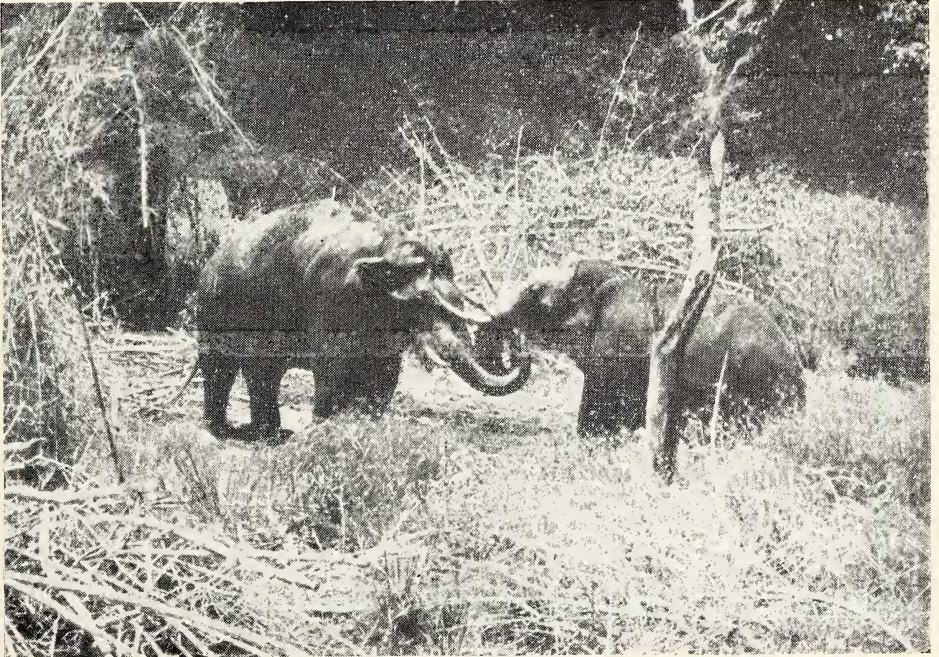


*Above* : MYSORE 1968 : BANDIPUR SA. : October 9 — a.m. : The 2 young tuskers in the water, Kollakumalikatté — MY. 3 ; *Below* : MYSORE 1968 : BANDIPUR SA. : October 9 — a.m. : Part of the herd entering the water, Kollakumalikatté — MY. 4.

(Photos : M. Krishnan)



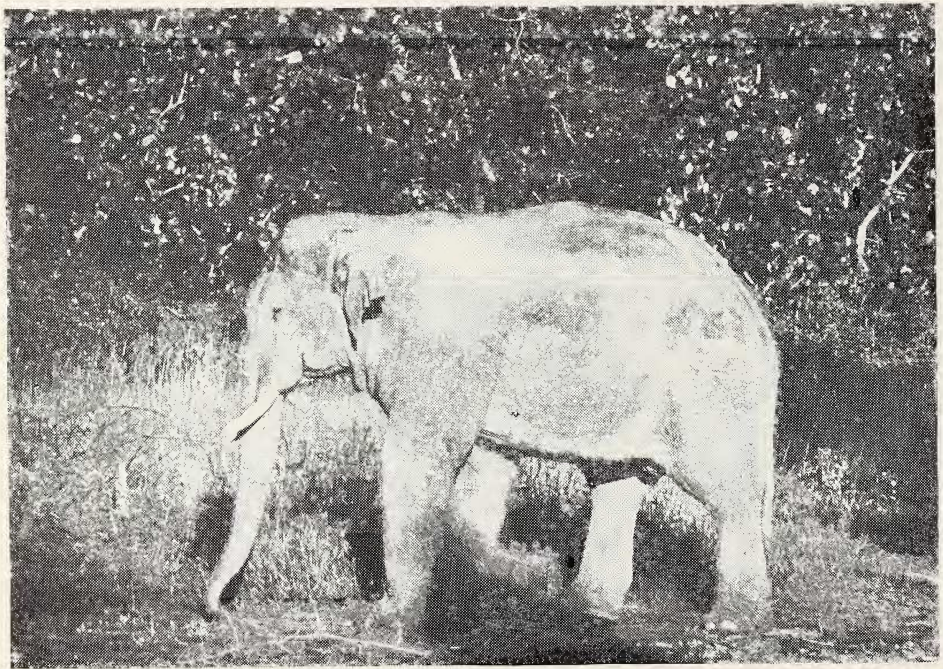
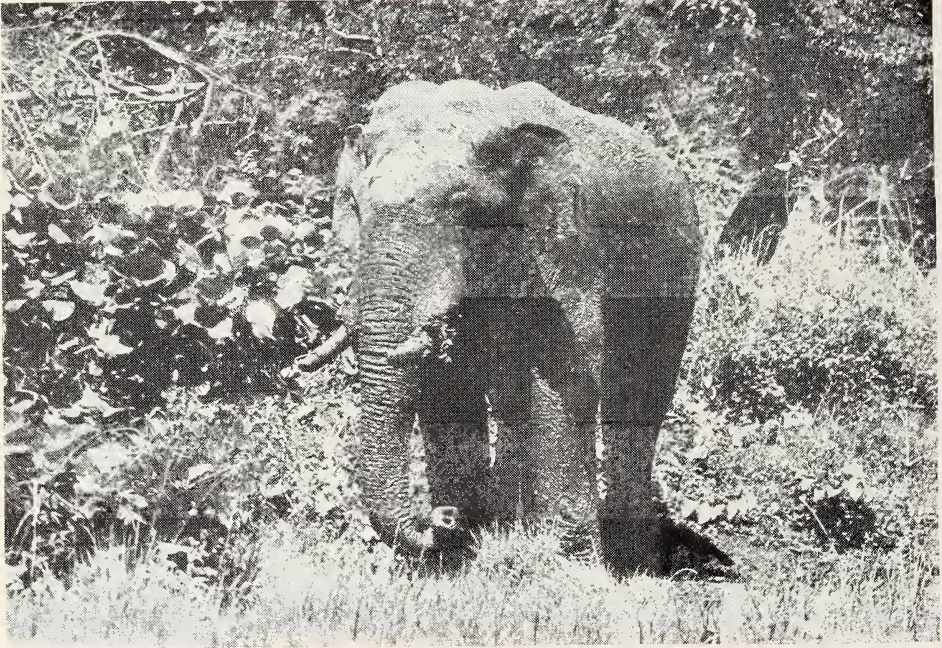
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*Above* : MYSORE 1968 : BANDIPUR SA. : October 9 — a.m. : The herd in the water spreading out in a semi-circle : Note outreaching trunks — MY. 5 ; *Below* : MYSORE 1968 : BANDIPUR SA. : October 11 — a.m. : Blunt-tusks and sharp-tusks — MY. 7.

(Photos : M. Krishnan)

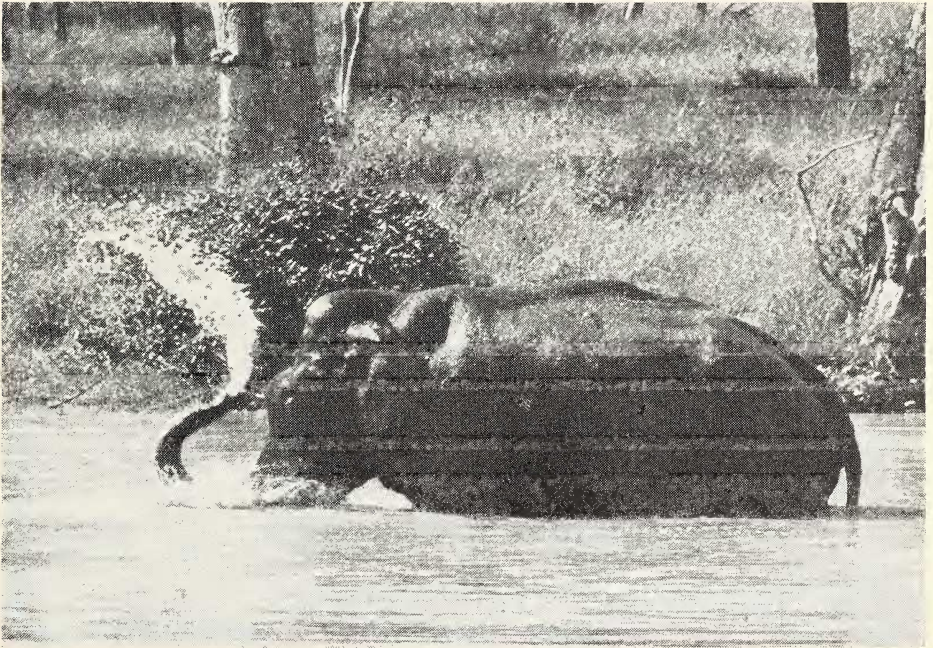
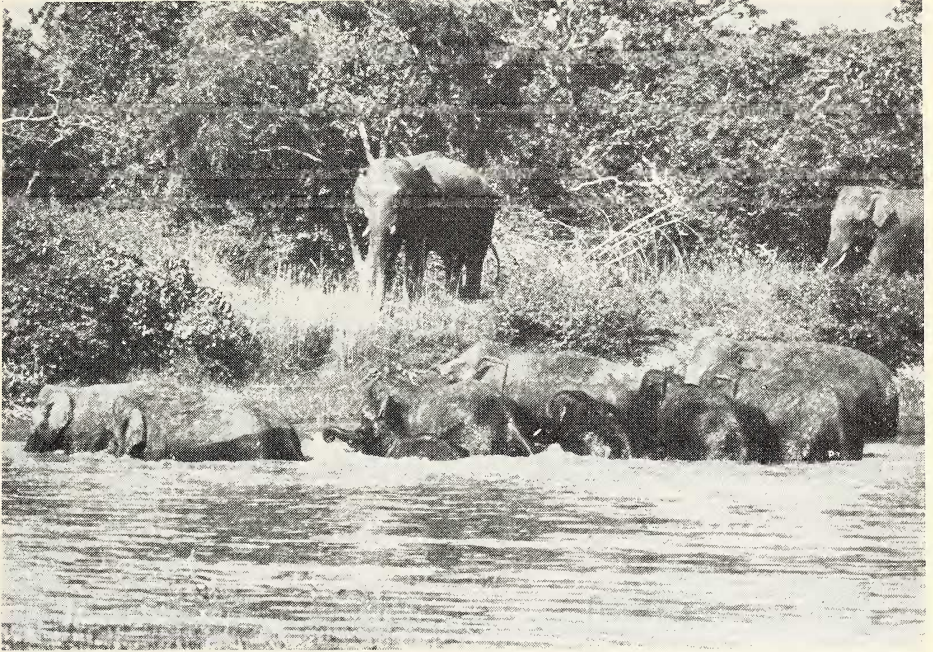
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*Above* : MYSORE 1968 : BANDIPUR SA. : October 14 — p.m. : Tusker covered with mud, near Yerekatté — MY. 9 ; *Below* : MYSORE 1968 : BANDIPUR SA. : October 21 — 5.15 p.m. : The tusker that followed our ground-scent to Sullukatté — MY. 10.

(Photos : M. Krishnan)

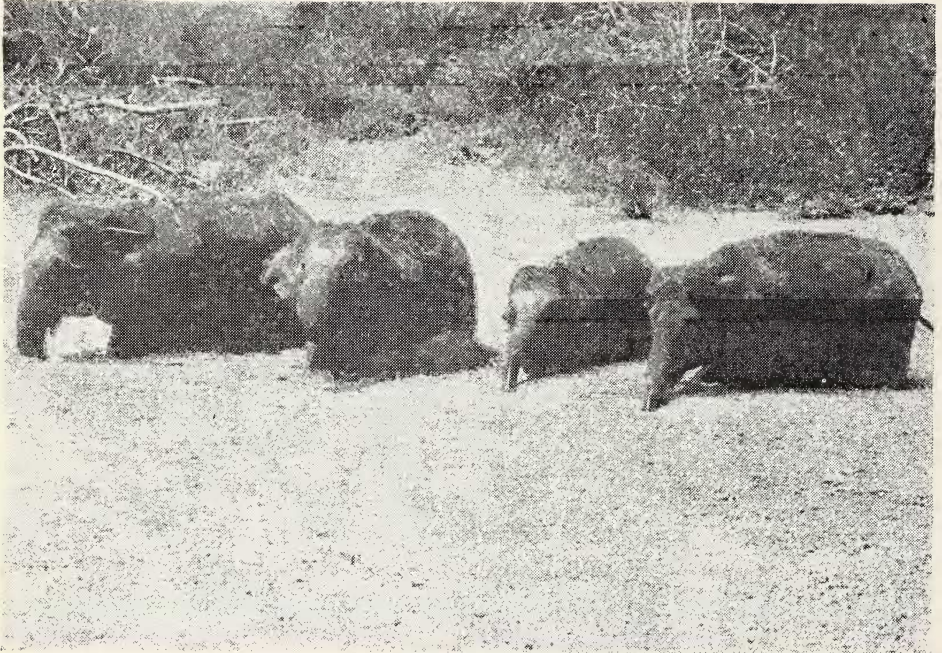
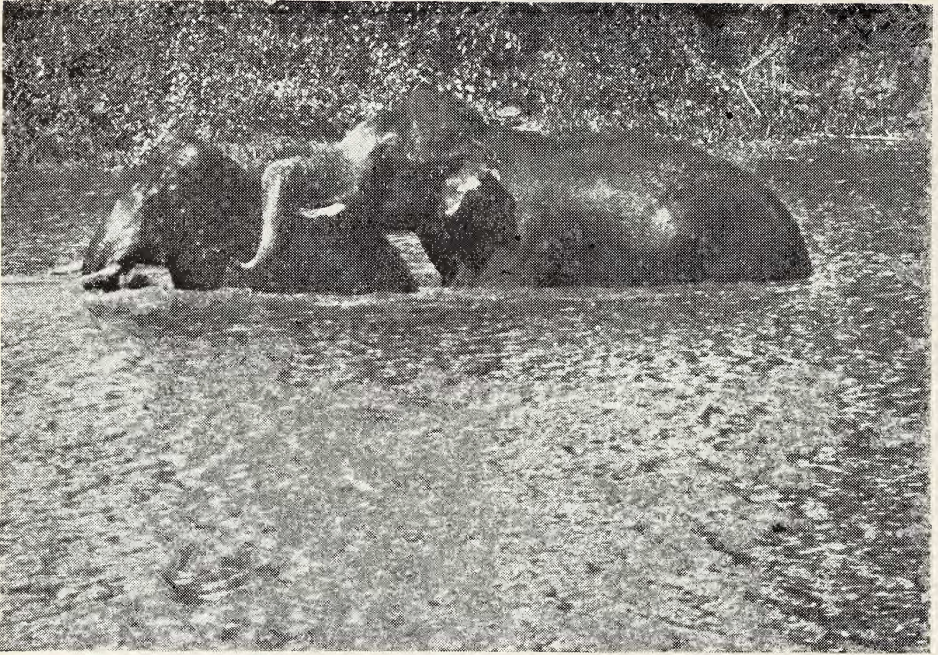
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*Above* : MYSORE 1968 : BANDIPUR SA. : October 25 — 2.15 p.m. : Elephants bathing in Yerekatté — MY. 16 ; *Below* : MYSORE 1968 : BANDIPUR SA. : October 25 — 3 p.m. : The koomeriah in Kollakumalikatté. Note outwardly directed spout from the trunk and the ridge of water thrown up by the downward slap with the tusks — MY. 17.

(Photos : M. Krishnan)

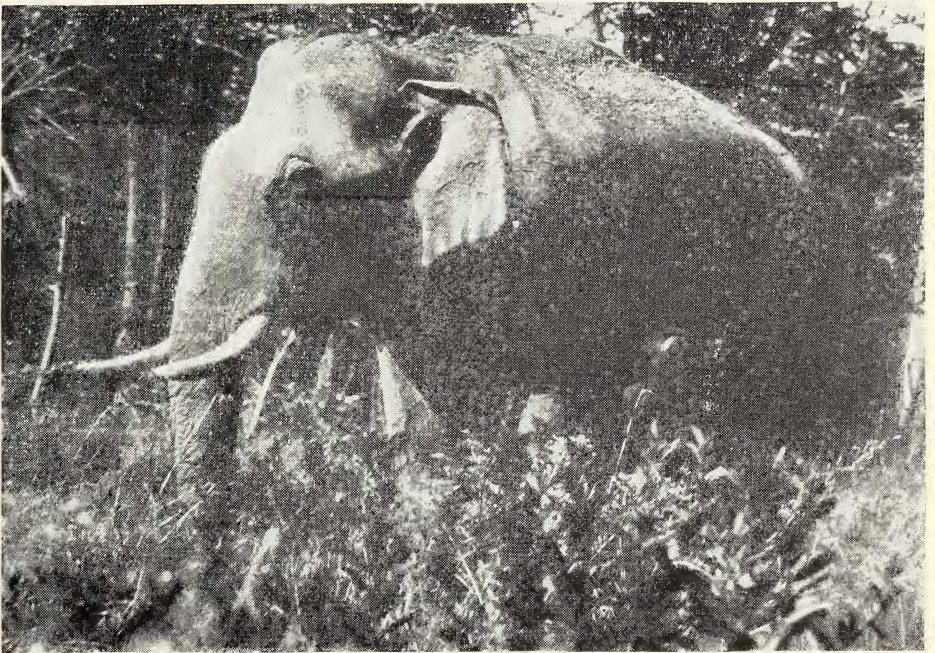
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*Above* : MYSORE 1968 : BANDIPUR SA. : October 26 — 10.15 a.m. : The 2 tuskers in Tavarakatté — MY. 19 ; *Below* : MYSORE 1969 : BANDIPUR SA. : October 10 — 11.30 p.m. : 4 cows and a young calf in Kollakumalikatté — Note duckweed — MY. 22.

(Photos : M. Krishnan)

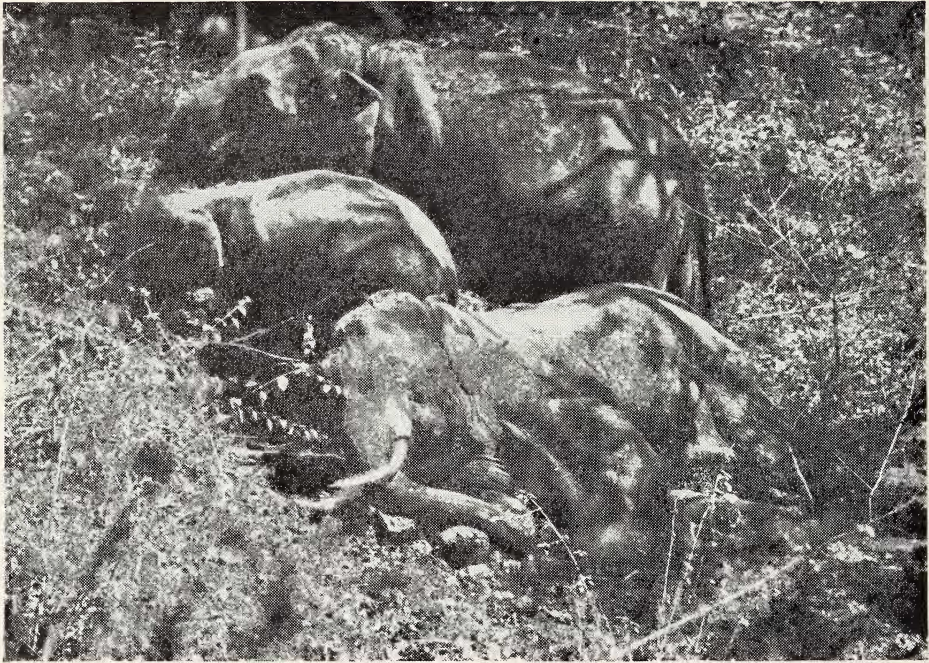
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*Above* : MYSORE 1969 : BANDIPUR SA. : October 11 — a.m. : Lone tusker feeding on twigs — MY. 23 ; *Below* : MYSORE 1969 : BANDIPUR SA. : October 25 — a.m. : Big lone tusker near road to Moolapura — MY. 35.

(Photos : M. Krishnan)

Krishnan : Mammals



*Above* : TAMIL NADU 1959 : MUDUMALAI SA. : Benne : March 30 — noon : Tusker having a mud bath — TN. 5 ; *Below* : TAMIL NADU 1959 : MUDUMALAI SA. : Benne : March 30 — past noon : Tusker drinking at a water-hole — TN. 6.

*(Photos : M. Krishnan)*

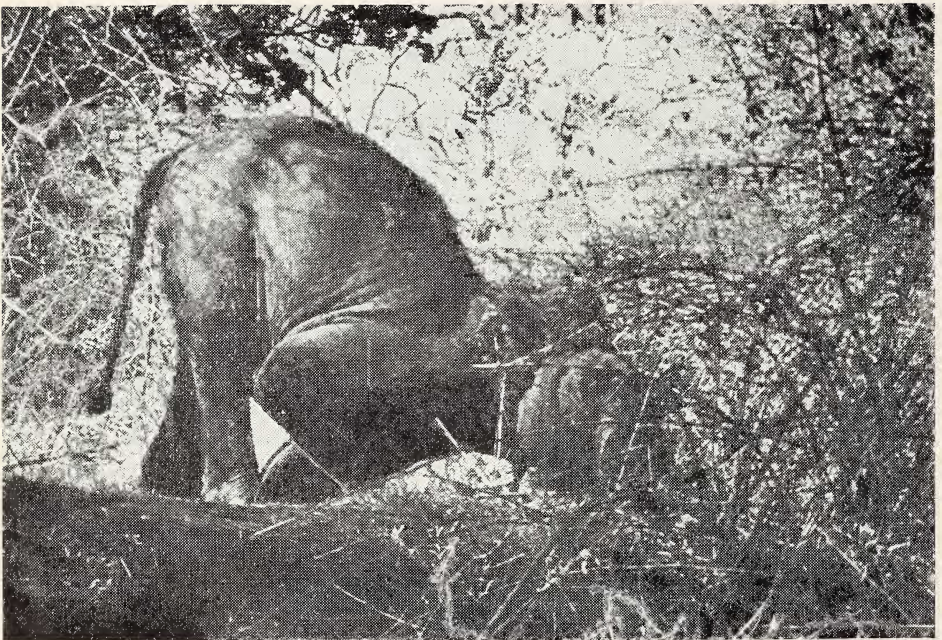
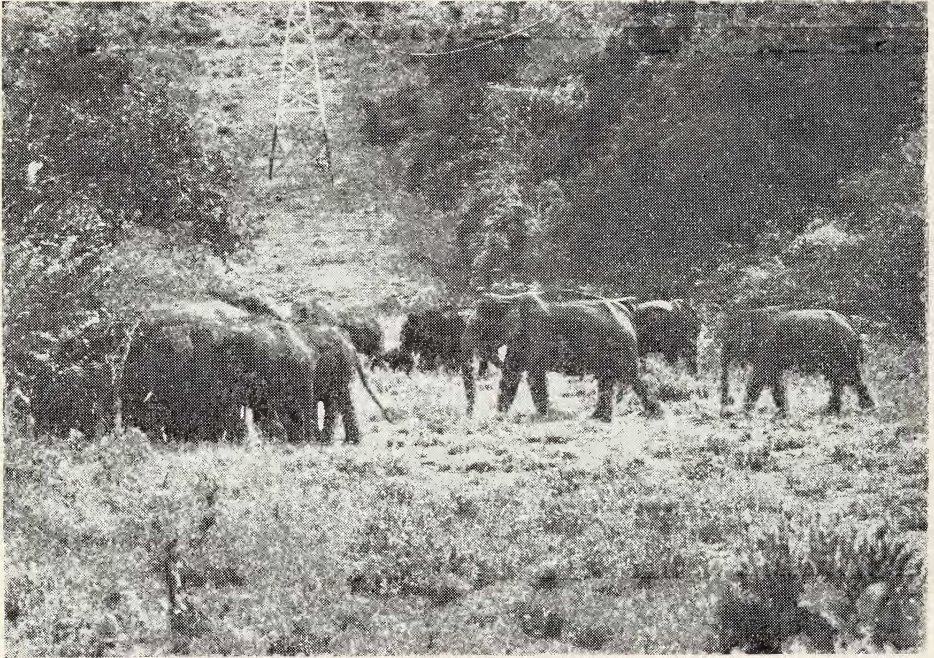
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Above : TAMIL NADU 1963 : MUDUMALAI SA. : Masinagudi : September 19 — a.m. : Elephants feeding on an *Albizzia odoratissima* — TN. 27 ; Below : TAMIL NADU 1963 : MUDUMALAI SA. : Masinagudi : September 19 — a.m. : The cow that followed me by scent like a bloodhound — TN. 28.

(Photos : M. Krishnan)

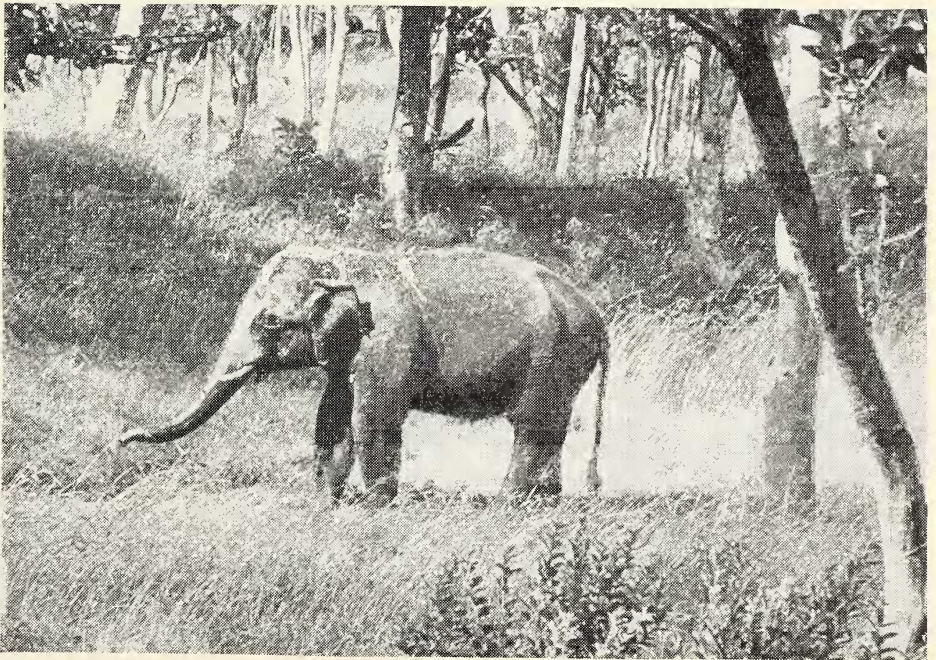
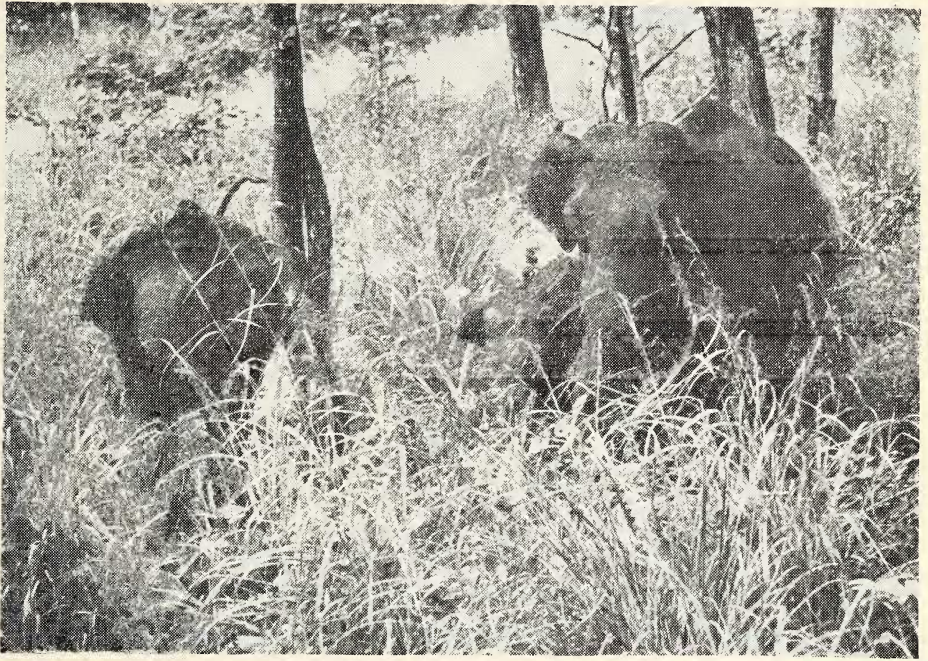
Krishnan : Mammals



*Above* : TAMIL NADU 1963 : MUDUMALAI SA. : Masinagudi : September 20 — near noon : Electricity comes to Elephant Country — TN. 29 ; *Below* : TAMIL NADU 1964 : MUDUMALAI SA. : Theppakkadu : March 25 — a.m. : Tusker demonstrating by goring a bamboo clump — TN. 33.



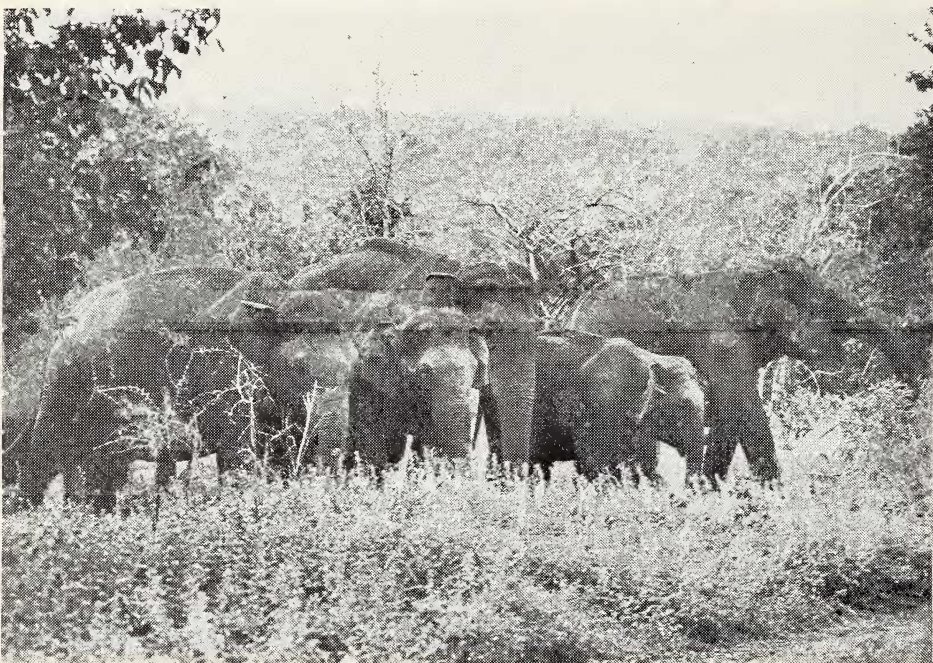
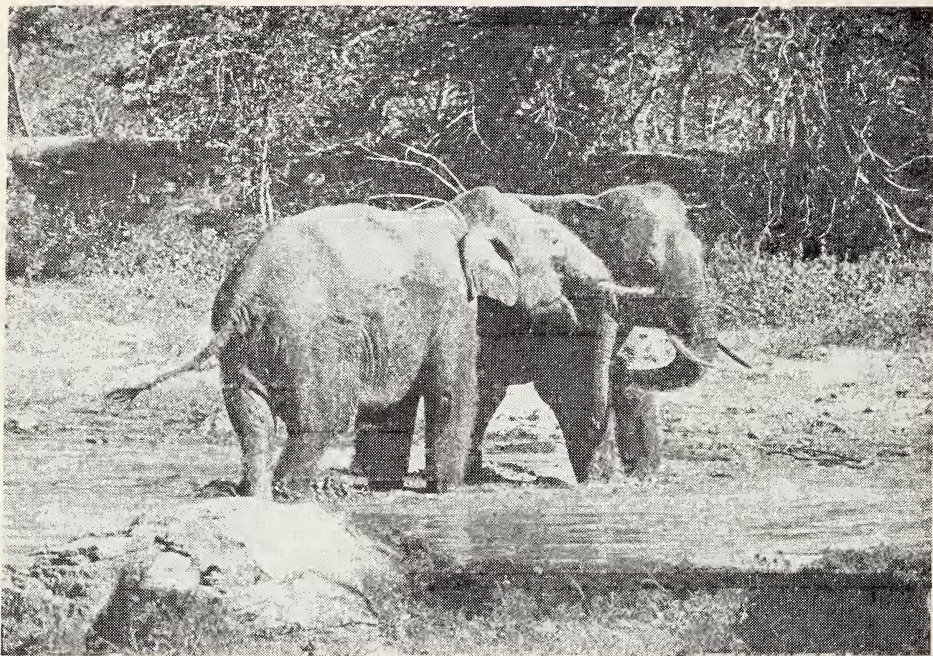
Krishnan : Mammals



*Above* : TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : September 18 — p.m. : The cow elephants (with a calf) that came for us — TN. 38 ; *Below* : TAMIL NADU 1969 : MUDUMALAI SA. : Kargudi : September 18 — 4 p.m. : Blunt-tusks of Bandipur, October 11, 1968 ? — TN. 51.

(Photos : M. Krishnan)

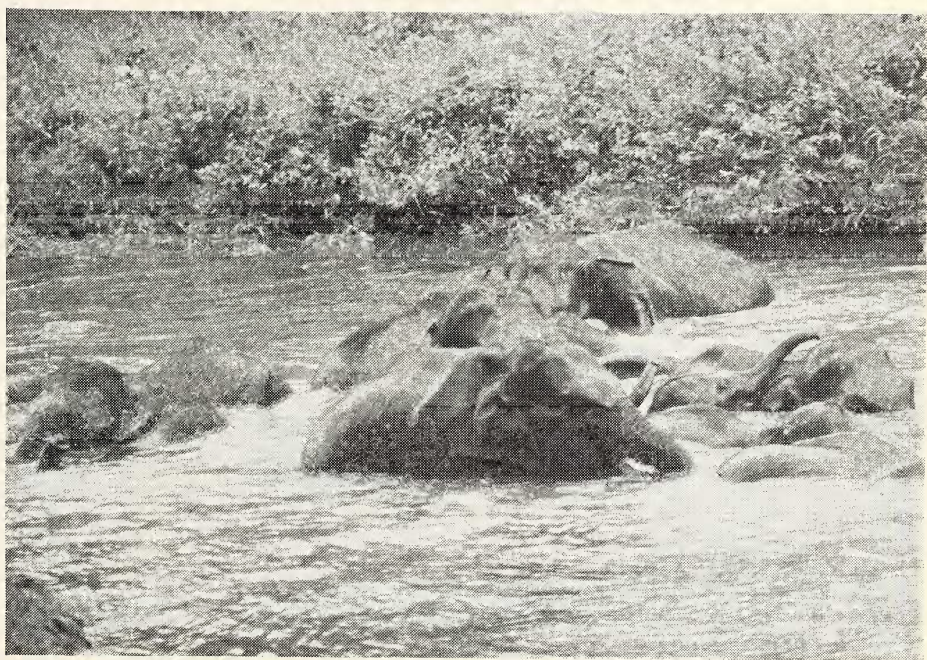
Krishnan : Mammals



*Above* : TAMIL NADU 1969 : MUDUMALAI SA. : Masinagudi : September 24 — near noon : The 2 tuskers by the pool — TN. 52 ; *Below* : TAMIL NADU 1969 : MUDUMALAI SA. : Masinagudi : October 5 — p.m. : The herd approaching the road — TN. 56.

(Photos : M. Krishnan)

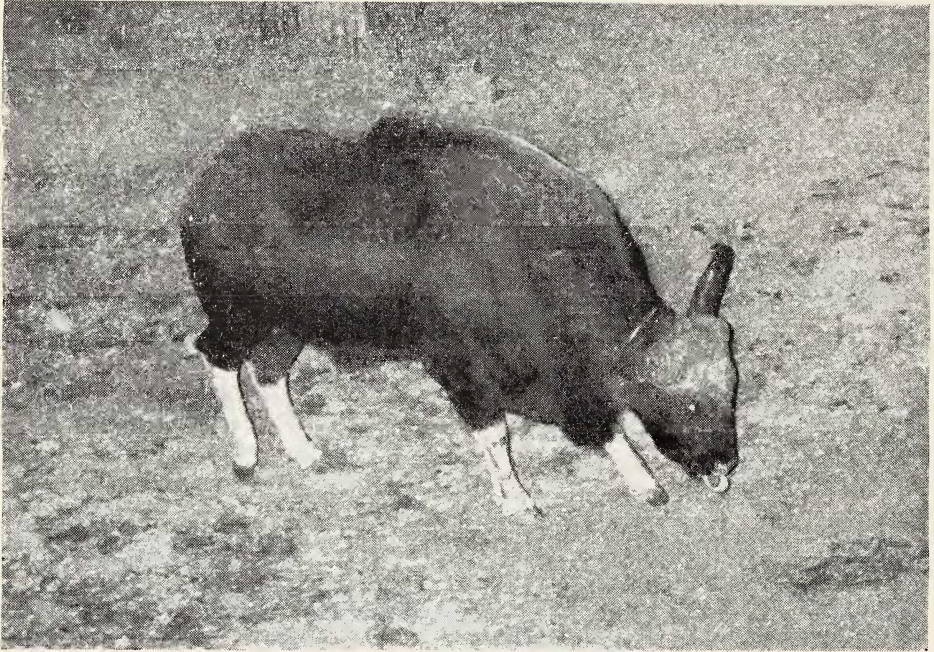
Krishnan : Mammals



*Above* : TAMIL NADU 1970 : MUDUMALAI SA. : Theppakkadu : September 28 — p.m. : The lone bull at the Moyar — TN. 61 ; *Below* : TAMIL NADU 1970 : MUDUMALAI SA. : Theppakkadu : September 29 — p.m. : The party of elephants bathing in the Moyar — TN. 62.

(Photos : M. Krishnan)

Krishnan : Mammals



*Above* : BIHAR 1969 : THOLKOBAD : Ligirda watch-tower : Night of February 3/4 — The bull with the brassy voice licking salt — B. 3 ; *Below* : BIHAR 1969 : THOLKOBAD : Ligirda watch-tower : Night of February 3/4 : The same bull in the previous picture with 3 subadults — B. 4.

(Photos : M. Krishnan)

a pink tinge to the grey. However the colour of a wild elephant is exceedingly difficult to judge, because the colour of the animal is so often that of the earth it has been throwing over itself—even a bright red elephant may be seen (K 70 May 5). Fresh from a bath, before they have dusted themselves with earth or thrown mire over themselves, elephants appear a gleaming black, and the lighter colour of an animal in the herd is then easily noticed. Some animals are definitely and noticeably light grey in colour (photograph TN 29; K 70 Apr. 22—photograph K11).

Calves up to the first 6 months of their lives may be covered with brown hair, not in a regular coat but in a loose tomentum. The colour of this hair may be quite light at times, a warm, yellowish grey, and may give the calf a light-coloured appearance. However this hair is not retained and such calves usually grow up into dark grey animals. The reports of 'white elephants' heard occasionally are based on people seeing such calves (TN 70 Oct. 5). No authentic white elephant (i.e. a notably light-skinned animal, a creamy-grey in colour with some pink in places) has been recorded within the peninsula.

In many adults, especially in old bulls, there may be much light pink speckling on the face, trunk and ears: the tip of the trunk is usually entirely pink in such animals (K 60 Apr. 10—photograph K6; K 70 May 6—photograph K 29, K 30). Sometimes a lacing of light pink may form a conspicuous border to the lower edge of the ears (photograph K 5: K 70 Apr. 22—photograph K 10).

#### *Distribution*

Prater gives the distribution as 'the forest-clad portions of India, Ceylon, Burma' and nearby countries. In Peninsular India, broadly speaking, the elephant is absent from Andhra Pradesh, Maharashtra and Madhya Pradesh, though these States hold many forests, especially hill-forests of the kind that elephants favour. There are wild elephants in Kerala, Mysore, the areas of Tamil Nadu adjacent to these 2 States, the interior hill-forests of Orissa, and parts of Bihar. In these States, elephants occur in broad belts of montane and submontane forests which have territorial and floristic continuity though politically they may be divided: for example, in the South elephants are found along the Western Ghats and associated hills and foothill forests.

Formerly, about 1000 years ago, there were extensive plains forests in the southern parts of the peninsula and elephants were found in such forests as well. The invasion of these areas by men and their conversion to human uses have driven away the elephants from the plains in many such places. To comprehend the changes in the distribution of elephants and other large forest-living animals (like gaur), which are gregarious and free-ranging, it is not enough to take note only of the

physical changes that have overtaken their known former homes and the causes that have led to their local extinction in places: such animals are unable to stand the disturbance of frequent human intrusions into their haunts, and therefore leave them if the disturbance is sustained. Place-names such as Anamalais and Kunjaramalai testify to the elephant's love of steep, forested hills.

*Habits: Behaviour*

Much of the daily activities of elephants centre around the two main features of their life: they need quantities of fodder (estimated at about 500 lb. of green fodder per adult) to sustain their great bodies, and half their time is spent in feeding, and they are highly gregarious and reassemble periodically after getting split up in the course of their search for food.

Although the largest and most massive of land animals, their peculiar build and anatomy enable them to ascend steep slopes, and they are remarkably expert at climbing hills (K 70 Apr. 20). There are few hills in the south whose tops are not marked by regular, well-defined elephant-walks: these are not just the tracks of a herd that has recently passed that way, but the well-tamped paths used and re-used by a succession of elephants: these paths always follow the easiest and safest gradients, and an expert engineer planning the best routes up and down a hill cannot do better than follow these elephant-paths. It is noteworthy that at times such paths follow the very edges of hilltops, with a sheer fall of a hundred feet or more to one side—elephants are exceptionally sure-footed and apparently never suffer from vertigo.

It is said that the fastest pace of an elephant, as when charging, is a fast walk or shuffle and that the animal cannot run. Even G. P. Sanderson, whose knowledge of elephants was extensive, deep and authentic, and whose authority still sustains many passages in recent books (for example, Ivan T. Sanderson's *THE DYNASTY OF ABU*) has fallen into the error of supposing that elephants cannot run: he says, 'the only pace of the elephant is the walk, capable of being increased to a fast shuffle . . . . . it can neither trot, canter nor gallop'. In the latter half of this statement he is perfectly correct—an elephant cannot trot, canter or gallop for the same reason that a man, when running naturally, does not trot, canter or gallop. The anatomy of the elephant is peculiar in that it has no hock as other quadrupeds have, but a true knee, like the human knee, that bends back. Therefore the elephant runs without leaping into the air, but it has two paces definitely, the walk and the run (TN 63 Mar. 24).

A consequence of their great bodily bulk is that they are virtually unsinkable, but they do not ride high in the water. They swim almost submerged, or just below the water, and the advantage of this when the

surface currents are strong is obvious. (K 59 May 19, 70 Apr. 22 & 23—photographs K 13, K 17). G. P. Sanderson records that a batch of 79 tame elephants he despatched across the tidal creeks of the Ganges were in the water for six hours without touching bottom in one swim, and that in the course of this and three other long swims not one was lost. He rightly observes that ‘full-grown elephants swim perhaps better than any other land animals’. The very young calves are at times reluctant to take to the water and are pushed in by their mothers or ‘aunts’ (K 59 May 19). In the water, young calves are helped by the support and guidance of the trunks of their mothers. G. P. Sanderson observes that older calves sometimes scramble on to the shoulders of their mothers during a long swim, holding on with their legs: I too have observed this. In crossing a broad, swift-running river they choose both the point of entry along a path sloping gently down the bank into the water and the point at which they clamber ashore on the bank across the water (K 70 April 22 & 29—photographs K 13, K 14, K 18)—they have regular paths for getting into the water and out of it, even into and out of a small forest pool (MY 68 Oct. 9).

Elephants bathe in forest pools and rivers entering the water carefully, fanning out, and then rolling over in the water, frequently submerging themselves (K 60 Apr. 10, 11 and 17; MY 68 Oct. 9, 25 and 26, 69 Oct. 10; TN 69 Sep. 19, 70 Sep. 28 and 29; B 69 Feb. 26—photographs MY 3, MY 4, MY 5, MY 16, MY 17 and MY 22; TN 61 and TN 62; B 21). They are not found in places where there is no source of drinking water, for they drink every day though they may not bathe every day. Baths are also indulged in during the rainy season, even when it is raining. A small water-hole may suffice to provide drinking water (TN 59 Mar. 30—photograph TN 6). They drink by sucking water up their trunk and then squirting it down their throats. The process seems reversible in a small measure. It is well known that, when feeling hot, an elephant will insert the tip of its trunk into its mouth, bring out some fluid and spray it all over itself. This fluid is not water from the elephant’s stomach, as it is said to be: it is not acid and does not turn blue litmus red. It is probably saliva.

Elephants draw muddy water up their trunks and squirt it over themselves, muddying the water with a forefoot for this purpose if it is too watery (K 60 Apr. 4). Water is also squirted in a shower over the back and head, and directed in squirts at the belly and head—an elephant feeling hot, cools itself in this manner. Where semi-solid mire is freely available, as at drying pools, it is taken up in lumps in the crook of the tip of the trunk and flung over the back, head and flanks (MY 68 Oct. 11; TN 69 Sep. 23).

A regular wallow is also indulged in: this may be when it is dry and hot, as in summer, or when it is cool, as on an overcast day in

September or October (TN 59 Mar. 30, 69 Sep. 23; MY 68 Oct. 6, 14 and 18—photographs TN 5 : MY 9).

Dust-baths are usually taken soon after climbing ashore from water, the dust being drawn up the trunk and blown over the head and back (K 60 Apr. 3, K 70 Apr. 22; TN 63 Sep. 19—photograph K 10). Dust is also sprayed over wounds to cover them (K 59 May 20). Earth, and salt-earth, is kicked up by the forefoot, and eaten (MY 68 Oct. 26; K 70 Apr. 22 & 30; MY 68 Oct. 25—photograph K 21). There appears to be a tendency among gravid cows to eat earth.

Apparently all this dusting and mud-bathing and mire-smearing serves to relieve cutaneous irritation or to provide some cutaneous gratification: the way elephants revel in baths, dust-baths, wallows and mud-slinging does suggest such a purpose. Calves under six months do not indulge in dust-baths or squirt mire over themselves because by that age they have not acquired sufficient skill with their trunk to put that most versatile organ to such uses: however, they wallow in the wet mud and in muddy shallow water.

Elephants also rub themselves, both when their bodies are covered with wet mud and when their skins are dry and clean, against the boles of trees. For this purpose a thick tree is chosen, often with a slight lean from the perpendicular, and they rub themselves against the bole on the side on which the bole leans towards the ground: such rubbing trees, covered with mud from about 3 feet to 9 feet up their boles, are often to be seen in the neighbourhood of forest pools (MY 69 Oct. 16; K 70 May 9).

One big bull chose and detached a dry twig while having a mire bath, and then scratched himself over the flanks and back with the twig held in his trunk (K 60 Apr. 4). Another bull with maggot-infested gunshot wounds rubbed himself against a ventek bole to detach the maggots from his wound (TN 59 Mar. 21).

In feeding, while the trunk is used to detach and convey food to the mouth, the forefeet are also used as adventitious aids, to crush and break up large fruits and small branches or bamboo culms, and to dust grass against. Watching elephants feed, one is impressed by the care with which they select and prepare each mouthful for ingestion: they are choosy feeders.

Fodder naturally varies with locality and season, and what follows is merely indicative of the many kinds of plant food they eat. They are entirely vegetarian, and while hard stems and twigs are also eaten, the bulk of their food consists of foliage and soft plant parts, or succulent herbs.

Many kinds of tall grasses (all those appropriately and loosely termed 'elephant grass') are eaten, as also some short grasses and purely herbaceous plants. Among the grasses commonly eaten may



be mentioned *Saccharum spontaneum*, *Ischaemum pilosum*, species of *Panicum*, *Sorghum* and *Themeda*, *Apluda mutica*, *Arundinella holcoides*, *Eragrostis gangetica*, *Hackelochloa granularis*, and *Paspalum scrobiculatum*.

Some sedges, and some plants of the Zingiberaceae such as *Costus speciosus* and *Alpinia* spp., are also commonly eaten.

All these grasses and succulents are torn out in a sheaf or bunch with the trunk, dusted vigorously, and placed crosswise in the mouth. This is a highly skilled operation to which we find no parallel in the feeding habits of other herbivores.

The sheaf is neatly packed before it is pulled out (the grasses usually by their roots): it is then dusted on the bent and raised wrist by being slapped sharply against it with a twirl of the trunk, or, especially when the bunch of fodder consists of short grasses with stolons or sedges, the trunk is formed into a double twist near its end and then violently untwisted in the air: this move generates considerable centrifugal force and the adherent mud and debris is sent flying away from the plant. When feeding in thick cover, when what is held in the trunk cannot be easily dusted against the foreleg, the trunk is raised high and the fodder swiftly twirled aloft to clean it. No doubt, in addition to clinging mud and dust and debris, the sheaf is freed of insects, snails and the like by these manoeuvres (TN 63 Sep. 19; K 70 May 6—photograph K 29—other observation notes and photographs, not reproduced here, support these statements).

The sheaf of grass is placed crosswise in the mouth, with the basal root part projecting from the lips on one side and the tips of the blades on the other; then, at a bite the projecting parts of the sheaf are bitten through and allowed to fall to the ground, and the rest is masticated and swallowed. When the grass is tender, the blades are consumed, and it will be found that the rejected parts of sheaves (which mark the passage of the animal in the course of its grazing) consist largely of the basal stalks and roots; when the blades are mature and hard, but basal culms are succulent, the apical part of the sheaf is rejected and the culms (with only the roots bitten off) consumed. The placing of the sheaf in the mouth and the consumption of a part of it is a selective action and not purely mechanical (TN 62 Mar. 15, 66 Apr. 23).

Bamboos (both of the genus *Bambusa* and *Dendrocalamus*) *Ochlandra* spp., and sugarcane and standing crops in fields are among the other grasses much fancied as food. In feeding on the giant bamboo, the entire clump is not pushed down: individual culms are selected, and these are either pushed down or pulled down, and then another culm is brought down. It is not only the foliage that is eaten, but also the

culm. Elephants will, on occasion, eat even dry bamboo fallen on the forest floor. Ratan cane is much fancied and eaten thorns and all (MISC 68 Feb. 4). Banana plants are pulled down, the stem split open with the forefoot, and the 'pith' eaten—a noticeable preponderance of banana fibre in the dung betrays overnight raids on plantations (TN 64 Apr. 12).

E. P. Gee told me, in 1968, that when the water hyacinth (*Eicchornia crassipes*) first invaded the bheels of Kaziranga, the elephants and other wild animals would not touch it, but in 1968 I found buffaloes and rhinos eating the exotic weed occasionally, and elephants less occasionally (MISC 68 Feb. 4 : photograph MISC 3). It is known that this plant has a considerable iodine content ; in fact, in an emergency it was utilised for the commercial manufacture of iodine. How far and in what ways the sustained intake (even in small quantities) of this iodine-rich plant will influence elephants (and other animals) is a matter which needs investigation.

Among the succulents eaten should be mentioned *Pandanus* spp. and *Ardisia solanacea*, both growing in brakes along forest streams : these provide a source of water even when the streams are dry in summer (TN 66 Apr. 15).

An exotic that seems to be more freely eaten now than some 25-30 years ago is lantana (TN 63 Sep. 19; TN 64 Mar. 21; TN 66 Mar. 30; TN 70 Oct. 4).

The bark of certain trees, such as *Kydia calycina*, *Grewia tiliaefolia* and teak, is skilfully stripped and eaten ; it is not the dry bark that is eaten, but bark that is sappy, especially the bark of saplings. To strip the bark from the tree, the elephant applies the ventral aspect of the base of the trunk to the tree with a firm pressure and then jerks its head laterally ; this causes the bark to split and get detached from the wood at that part, in a strip some 4 to 6 inches wide ; the lower broken edge of the strip is then gently lifted up with the trunk till the bark is stripped as high as the trunk can go and hangs from the bole ; then this strip of bark is held lax in the trunk and given two or three preliminary oscillations and then one quick upward flick, that detaches it for another 2 or 3 feet up the trunk. After eating this, another strip of bark next to the peeled strip is similarly peeled and consumed (TN 63 Mar. 24). It was noticed that in a *Kydia calycina* almost completely stripped of bark in 1963, by summer next year new bark had covered the wood (TN 64 Apr. 14).

Many shrubs and small trees are eaten, foliage and twigs together ; among these may be mentioned *Helicteres isora*, *Grewia aspera* and other species, *Hibiscus lampas*, *Acacia concinna*, *A. intsia*, *A. ferruginea*, *A. catechu*, *Cordia myxa*, and *Zizyphus xylopyrus* (TN 63 Sep. 24, 64 Mar. 21, 66 Mar. 30, 69 Oct. 1 ; MY 69 Oct. 11—photograph MY 23).

*Phoenix humilis* is much liked, the foliage and the fruits both being avidly consumed.

In the South, it is not rare to come across *Buchanania latifolia* saplings in the forests that look as if they had been pollarded: wild elephants eat the crown of this tree when it is in new leaf, to give it this appearance. *Emblica* sp. and *Ficus mysorensis* and other species, *Premna tomentosa*, *Elaeodendron glaucum*, *Albizia odoratissima* and other species, *Diospyros* spp. and *Bauhinia racemosa* are among the trees whose foliage is regularly eaten (TN 63 Sep. 19, 64 Mar. 21, 66 Mar. 31, 69 Oct. 1; MY 68 Oct. 20, 69 Oct. 11).

The aerial roots of the banyan are much fancied, and regularly broken off at the level of the elephant's reach, as they regrow (TN 69 Oct. 1).

I have seen elephants laboriously gathering and consuming the flower heads of *Mimosa pudica* (TN 59 Mar. 21, 62 Sep. 12). Flowers do not form any significant part of their diet, but they painstakingly collect tiny morsels that they specially fancy.

A variety of forest fruits are eaten, among them *Aegle marmelos*, *Artocarpus integra* and *A. hirsuta*, *Careya arborea*, *Cordia myxa*, *Emblica* spp., *Feronia elephantum*, figs, *Pandanus* sp., and *Randia uliginosa* (TN 64 Apr. 5; B 70 Feb. 26). The grain of seeding bamboos, and the seeds of *Cycas* are eaten.

The substantial part of the food of elephants consists of grasses, sedges, other herbaceous plants, and bamboos.

Young calves subsist on their mother's milk up to the age of about 6 months, when they begin to feed on grasses and herbs. They may be suckled occasionally till they are 3 years old. A young calf is singularly clumsy with its small, undeveloped trunk, which it lays against the axilla of its mother while sucking milk (K 70 May 1—photograph K 25), and it is only as it grows up that the trunk develops and it acquires skill in the use of the organ. The breasts of a cow elephant have a slight outward lean, towards the flank, and this facilitates suckling the calf (photograph K 38).

Elephants and gaur are usually found in the same forests, and it has been said that they feed amicably together. This has not been my experience. No doubt gaur benefit by following in the wake of elephants, and consuming the bamboo and other tree foliage pulled down by the latter, but elephants do not allow gaur to feed along with them (TN 62 Apr. 10). In their feeding, they keep in a group or feed by themselves, and are quite unsociable. They do not like the company of other animals even at forest pools and drive them away, or where the water is tainted by other animals having drunk at the same pool, scrape fresh water-holes for themselves with their feet (TN 69 Sep. 23; B 69 Feb. 26).

In its period of infancy and growth to adolescence and maturity, and in its longevity, the elephant bears striking points of resemblance to the totally unrelated human being. A cow elephant may be said to be adult at 16 years of age, and is capable of breeding then, though still not full-grown, and a young bull at 20. Gain in height, and especially in substance, continues till the animal is 30: it is in its prime from 30 to 40, middle-aged from 45 to 55, and definitely aged at 60, though it may be often quite robust still. Cow elephants continue to breed till about 55 years old, and seek the society of bulls even when past 60 (TN 70 Sep. 23, 27 and Oct. 3).

In recent years, doubts have been expressed by some foreign writers on the elephant really being a long-lived animal, and it has been said that it does not live to beyond 70 years. No doubt it exceeds this classical span of three-score-and-ten on occasion, even as men do, when free and wild. Anyone who has some knowledge of wild elephants in India will appreciate how much better conditioned than tame elephants they are, and how much less subject to wear. G. P. Sanderson has argued this point ably.

The periodic occurrence of musth in adult elephants, marked by a dark, oily exudation from a temporal gland with a pore on either side (roughly midway between eye and ear) and a tender swelling of the temples and forehead, is something peculiar to elephants and its full significance is not yet known (photographs K 5, MISC 2). Little that is an original addition to what G. P. Sanderson wrote about musth a century ago is available in the literature on *Elephas maximus*. Musth does seem to have some sexual significance, though it is not, as popularly supposed, merely an expression of abundant virility. Musth afflicts old elephants as well, and some animals in musth are in very poor condition—in what follows, the manifestation and consequences of musth in tame elephants have been left out of reckoning as so many artificially-imposed conditions supervene then that it is not safe to draw any conclusions from the behaviour of tame elephants when in that condition. Almost invariably, it is an adult bull that gets into musth, but in rare cases a cow may do so. G. P. Sanderson records two instances of cows in musth, ‘in newly-caught females in the prime of life, and in very full condition’. During the long period of pregnancy (one of the longest among all mammals), before a cow is far gone in calf, she does often give the impression of being, not obviously pregnant, but in very full condition. All the cow elephants I have seen in musth were probably pregnant: of the 2 observed within the survey period (B 69 Feb. 19 *et seq.*; K 70 Apr. 22—photograph K 11), one was heavily and patently pregnant, and the other was very probably pregnant, appearing to be well-fleshed and in full condition. It could

be that the rare incidence of musth in cow elephants is in some way related to pregnancy.

Bulls in musth often exhibit a marked lethargy, as remarked by Sanderson; this lethargy does not manifest itself in immobility or slowness of movements, but in a marked indifference to the surroundings—a bull in musth often appears to be in a state of somnambulance, though its stride is not shortened. This, however, is not an invariable feature of musth. Some bulls in musth observed were wide-awake and even aggressive, for example a tusker in West Bengal (MISC 65 Oct. 22—photograph MISC 2), a muckna in Assam (MISC 68 Feb. 10—photograph MISC 4) and a tusker in Mysore (MY 68 Oct. 9 and 25—photograph MY 17)—the last, when first seen, was in a highly excited state. Other elephants in musth have exhibited that somnambulistic indifference to their surroundings that made it possible to approach them closely for a picture (K 60 Apr. 10—photographs K 5 & K 6: MISC 68 May 18—photograph MISC 6: TN 70 Sep. 27). In a party of elephants it was noticed that the cows were attentive and considerate to the tusker in musth (TN 59 Mar. 30). Bulls in musth frequently squirt water over their swollen musth glands and forehead, and apparently the lavage serves to unclog the musth pores (photograph K 6). A tusker in musth invaded the elephant camp in Kargudi (in the Mudumalai Sa.) and mated with a cow that was in season—his aggressiveness towards men was not caused by his condition, but due to his resentment of being closely watched by crowds, and shouted at (TN 64 Mar. 22, 25 & 28).

A peculiarity noticed in tuskers in musth is that they often carry tight-packed clay on their tusks, so closely adherent that even a swim in fast-flowing water does not wash it away (K 60 Apr. 10—photograph K 6). This adherent clay is acquired when the tusker gores earth banks and even the clayey bottoms of forest pools while in musth: this goring is not something done in a frenzy, but evidently indulged in to cause the free outflow of musth from the temporal glands by the pressure imposed on the swollen glands by the goring (MY 68 Oct. 25: MISC 68 May 18). The duration, periodicity and heaviness of affliction of musth all vary with individuals, and even from one bout to another in the same individual. At times the exudation is thin and at times so profuse that it stains the entire cheek and runs down the face.

As among most herbivores, the sexual act occupies only a very short time, less than a minute (TN 64 Mar. 30—a.m.), but the love-play preceding it is elaborate: coition is usually repeated many times during three or four days the bull and cow are together—even when in a herd, the pair are seen by themselves when the cow is in season and has accepted a bull (K 60 Apr. 5). The belief held by many professional elephant men that the cow decides with which bull she will mate seems

to be factually sound, although it is also true that rivalry among adult bulls may become acute when a cow is in season. In elephant camps it is not unusual for a wild bull to arrive at the camp when a tame cow gets into season, and frequently the first act of the intruding bull, even before he seeks the cow, is to attack other adult tame bulls in the camp. In the Kargudi elephant camp of the Mudumalai Sa., two adult tuskers personally known to me (Caesar and Addi) were grievously wounded by wild bulls attracted to the camp by a cow coming into season. As in most other mammals, the condition of the cow is advertised by scent, but the elephant is unique in that a cow in season actively advertises her condition. Visually flagrant signs of her being in season are not manifested (even the mahouts know that their charges have come into season mainly by circumstantial evidence, such as the interest manifested in the cow by the bulls), but the cow bends her tail between her hind legs sharply so as to slap the abdomen with its tip, and then draws the brush at the tip firmly up, rubbing it against the vagina: the tail is then held aloft in the air and waved about, in a scent-flag (TN 64 Mar. 25).

While it is true that in most animals the male cannot mate unless the female is co-operative, the peculiar anatomy of the elephant and its courtship habits makes it absolutely necessary for the bull to have the co-operation of the cow for successful coition. Because the pre-copulatory play is gentle in the elephant, the bull cannot, by aggression or force, compel the co-operation of the cow—a situation that may arise in some other animals where there is little courtship prior to the sexual act. During this phase of courtship, the bull caresses the cow with his trunk and there are repeated gentle bodily contacts. While the bull elephant is not specially peculiar in his genital anatomy, except that the testes are not discrete in a scrotum but located within the body (a feature shared by some other animals, such as the whales and dolphins, shrews and sloths), the cow elephant has the widest perineum known among the mammals, and her vagina is situated low down, a vertical slit at the end of the abdomen; this renders it quite necessary for the cow and the bull to be precisely aligned before copulation can be effected; the bull lays his trunk along the cow's back from behind and manoeuvres her into position before attempting to mount her, a move dependent entirely on the willingness of the cow. During the brief period of copulation the animals move around in a quarter circle—this was noticed in two matings between wild elephants observed from far off and also in the mating between the camp elephant Suguna and a wild tusker observed and photographed from near (TN 64 Mar. 30).

The rule is one calf at a birth, but occasionally two are born. The camp elephant Tara, stationed at the Kargudi camp of the Mudumalai Sa., had twins some years ago from a mating with a wild tusker. In a

gregarious animal that is unusually exclusive in its intraspecific associations, the relationship between the adults in a herd and the infants and juveniles assumes a special importance. G. P. Sanderson provides a succinct and excellent account of the extraordinary consideration for the young animals in a herd shown by the adults, but on one point he seems mistaken. He concludes that cow elephants display no special solicitude or attachment to their calves, permitting men to handle their newborn young, and that from what he has noticed during the capture of elephants in stockades, the young calves of a cow are often violently repulsed by the other cows in the herd. Tamed elephants, used to having their needs, and directions, provided by men, might not show any apprehension at their infants being touched by men: my experience is that the most dangerous and aggressive of all elephants is the mother elephant (or even the 'aunt') apprehensive for the welfare of her calf; a remarkable instance of this was provided by two small cows, with a calf about a year or two old (the calf of one of them) between them, which came baldheaded for the riding elephant (a tusker much bigger than them) on which I was seated along with another companion and the mahout, because the tusker had been moved inadvertently close to the calf (TN 64 Sep. 18—photograph TN 38). While it is true that cows in a herd do repulse the calves of other cows on occasion (K 70 Apr. 21), it is patently incorrect to assume that the behaviour of any animal when it is confused, and panic-stricken and cannot escape, is its normal behaviour: as several observers have pointed out (especially Williams, to whom we owe the word 'aunt') not only are cow elephants very patient with their own calves, but quite often they develop an attachment and a protective feeling towards the calves of other cows to whom they are specially attached. The camp elephant Rati at the Mudumalai Sanctuary, is known for her attachment to all young calves born in the camp. Occasionally both the mother of a calf or another cow may kick or push the youngster when it is being recalcitrant (K 70 April 21) but this is always intentional, and by and large in few animals are the young in a gregarious association treated so gently and solicitously as in elephants.

It is well-known that in a herd certain adult cows develop a deep attachment (which can only be termed 'friendship') to certain other cows. Bulls, too, keep together when foraging apart from the herd, and it is a common sight to observe two or three 'lone bulls' together. This attachment of one cow to another has been observed both in the wild and among tame elephants. Indeed, so well is this recognised that in elephant camps they are not separated from each other even when put to work (as when used for timber logging) not out of any sentimental motives but because otherwise the work suffers. During the period of the survey it was noticed that the camp elephant Rati (a

fine upstanding cow in her prime) could not be used as a riding elephant at the Mudumalai Sanctuary, unless the aged Sundari was also taken along with her. Among wild elephants, the tendency of certain members of the herd to group together when the herd splits into parties for foraging may be noticed (TN 66 Apr. 21).

Some of the vocalisations of elephants are well-known, such as trumpeting, squealing, squeaking (the two terms are used to distinguish a louder sound of protest from a weaker and softer sound, usually of pleasure in elephants), roaring (usually indulged in by juvenile elephants of from one to 5 years, when separated from their mothers in the course of foraging), and a sudden metallic and at the same time tympanic sound made by rapping the trunk sharply against the ground (the sound seems to be produced mainly by the sudden percussive of the column of air in the trunk as it is expelled) which is a sound of apprehension and interrogation—strictly speaking, not all of these sounds are vocalisations, since some are produced not in the throat but in the trunk. Other vocalisations are less well-known and may be briefly set out here. One of these is a plaintive, reiterated ‘kook-kook-kook’, sounded when the animal suddenly discovers something that annoys it (such as the near presence of a man—TN 66 Apr. 9): it is a sound of protest, but I have also heard it used by an exceptionally burly tusker that was demonstrating at us and covering the retreat of the herd (which we were following) evidently as some form of communication to the herd. Very young calves (under 2 months) come out with a loud, quickly-repeated bark that is very like the barking of a dog (though louder and flatter), a sound that is known to very few mahouts, for it is not uttered by calves in elephant camps: it can be heard only from the calves of wild elephants, and seems to be an expression of exhilaration (TN 66 Apr. 22, 69 Sep. 23, 70 Sep. 29, Oct. 5). Older calves do not indulge in the vocalisation.

A loud, repeated smacking, made with the lips, is commonly employed by the leading adult animals in a herd when the herd is on the move and somewhat uneasy over what lies ahead (TN 69 Oct. 5): an adult cow smelling at the rump of another adult cow was also heard coming out with this smacking sound (K 70 May 4). Frequently, when the herd is grazing in the open (never in cover), the adults converge in a close circle, with their heads facing the centre, and seem to confer together; after such a conference, the animals usually move away steadily in one direction, keeping close together and not in a loose formation as when grazing (K 70 Apr. 20): I have never been able to get sufficiently close to elephants in ‘conference’ to know whether or not they make any sounds then, but believe they do come out with some soft, low sounds—they certainly do indulge in tactile expressions with their trunks then. Among tame elephants, two cows may be seen



standing close together, almost in a huddle, caressing each other with their trunks and coming out with throaty, hardly-audible sounds—this is especially noticeable when two cows that are attached to each other meet after a separation.

Elephants in a herd are sometimes quite noisy, and at such times they are apt to be belligerent, and specially aggressive towards human intruders (TN 63 Sep. 19 and 20). The many vocalisations of a herd are often missed when observing elephants by day (partly, no doubt, because one is then preoccupied with seeing what one can), but in the stillness of the night and when conditions are specially favourable for hearing the sounds made, as when the elephants are grouped around a sheet of water (which acts as a most efficient sounding-board), grunts, grumblings, squeals, squeaks, trumpeting, 'kook-kook-kooks' and softer and less definable sounds may all be heard (K 70 Apr. 23). A sound which elephants frequently utter when they are alone (maybe in a herd the sound is drowned by the other sounds made by the animals) is a deep, audible sigh, made by the expulsion of air through the trunk—it is the one sound made by an elephant which is otherwise keeping utterly silent, and a sound for which men in elephant jungles must always listen.

Many observers have recorded becoming aware of the presence of wild elephants by hearing their intestinal rumblings—this, of course, is purely involuntary and no sort of vocalisation, even stretching the term to its widest application. But on occasion, an elephant, while standing still, will come out with a vibrant rumbling sound, low-pitched but clearly audible from some distance, that is a sound made in the throat, though the flanks also appear to vibrate while it is made. It is a sound difficult to describe, something between a low growl and a throbbing purr. A charging elephant may come on in silence (TN 69 Sep. 20) or utter a piercing, malevolent scream (TN 64 Mar. 30).

As in other mammals, intraspecific communications and expressions of mood and intent are not limited to vocalisations. The attitude of an elephant, the way it stands and moves, and the way it holds its head, tail, ears and trunk are all expressive of its emotional state. An elephant in a rage stands very still, without swinging its trunk or flapping its ears—the ears are held flat against the neck (K 59 May 20). When the animal is at peace with the world, the trunk is swung freely and the ears are flapped from time to time; when the head is held high and movements are brisk, it is in high spirits. When undecided or perplexed, the tip of the trunk is sometimes inserted into the mouth or, in a tusker, the trunk is draped over the tusks and hangs from them. It is curious that both these ways of disposing of the trunk are repeated in sleep. K. Krishnamoorthy once observed a proscribed rogue (which he shot later) asleep on its side, with the tip of its curled up trunk

reposing safely in the mouth, and in a big tusker observed by me sleeping standing, the trunk was draped over the tusks (K 70 May 6). Instinctively, elephants take good care of their trunk (a vitally important organ to them) both in repose and in action. When alarmed and on the point of bolting, the tail is thrown up and the head raised, with the ears fanned out and then folded back, an attitude that serves effectively in visual communication of the alarm to the other elephants around (photograph K 27).

The elephant's vision is said to be poor, but it seems to be much better than reputed. It is true that the animal is not good at picking out stationary human beings inconspicuously clad in dark colours—but for this, I would not be writing this report. As against this inability (an elephant's inability to see what is right beneath it, such as a man crouching in a bush, is no doubt partly due to the bulge of its cheeks and the base of its trunk), the fact that a great many intra-specific signals are usually sensed visually must be offset. An old cow returned to the water at which a younger cow was lingering after the rest of the party had left after drinking, stood on the bank for a moment and then moved off, when the younger animal instantly followed (TN 70 Sep. 24): I have observed this mode of beckoning to a member of the herd that lags behind on a few previous occasions as well. An elephant in cover wishing to cross an open space to get to other cover beyond inspected the open ground visually and also investigated it by smelling; before crossing it (TN 66 Apr. 9). At times, when it has been apprised by smell of the near presence of a man, an elephant turns round for visual confirmation of its olfactory perception (TN 63 Sep. 19: MISC 68 Feb. 19—photograph MISC 4).

The sense of smell, of course, is paramount. Even apprehension of fodder specially fancied seems to be by smell—a near-blind riding elephant was still able to know that a tree, the foliage of which she liked, was some 15 feet to one side of the path she was following, and to alter her course to eat the foliage. The presence of men near-by is often revealed to an elephant by smell, when it instantly pinpoints the smell with the tip of its trunk—it also looks hard in that direction (MY 69 Oct. 16; K 70 May 1 and 10; TN 70 Sep. 28—photographs K 22, K 43). On two occasions, when I provoked a tusker to charge me, the animals instantly charged the moment I gave them my location definitely by walking into the wind (TN 63 Mar. 30 and 69 Sep. 20). Even the reverse of the seeking of visual confirmation of the proximity of men perceived initially through smell was observed, i.e., olfactory confirmation sought by the trunk being pointed in the direction of the men seen, when the animal could not possibly smell them, the wind blowing from it to the men (K 60 Apr. 16: MISC 65 Oct. 22; TN 70

Sep. 27—photograph MISC 2). When an airborne scent is above the level of the elephant's head, the trunk is raised high to investigate it.

Elephants are well able to follow ground-scents, like blood-hounds. A cow followed me entirely by ground-scent, with a strong wind blowing from her to me (TN 63 Sep. 19—photograph TN 28) and on two occasions wild tuskers followed the tracks of the tame elephant I was riding by ground-scent (TN 64 Apr. 10; MY 68 Oct. 21—photograph MY 10): another wild tusker was observed sedulously following a ground-scent, probably the track of a wild elephant (TN 66 Apr. 21).

G. P. Sanderson says that when there is an alarm, the big bull of a herd runs away on his own and does not cover the retreat of the herd. This is generally true, but on occasion the bull does cover the retreat of the herd. Once, when I was following a herd along with some trackers, we were halted by a singularly burly and powerful tusker which stayed behind while the rest of the herd moved into thick tree cover, and staged a most impressive demonstration, pushing over a stout sapling and then kicking it between his legs: later, when we had been halted, he moved off in the wake of the herd. Frequently such demonstrations to intimidate and halt men take the form of pushing over trees or goring small clumps of bamboos or bushes (TN 64 Mon. 25—photograph TN 33). A cow may demonstrate at a man following her by turning round and rushing towards the intruder in a short, formal charge (K 70 Apr. 22 and 29). Sometimes an elephant, resenting the presence of a man, may graze gradually towards him at a tangent, and then turn in sharply for a charge when near enough (photograph K 30).

The elephant is one of the few mammals that, even when adult, indulges in play. When bathing in company in a forest pool, it is not only the juveniles that revel in play: even the adults bump into, push down, and roll over one another with abandon—perhaps they find the sudden lifting of their ponderous weight off their feet by the water exhilarating (K 60 Apr. 11 and 17; MY 68 Oct. 26; TN 70 Sep. 29—photographs MY 16 and 19, TN 62). On land, too, adult bulls may indulge in a long bout of play with their trunks, not in a tug-of-war so much as a pushing match, or in chasing each other (TN 63 Mar. 24, 69 Sep. 23 and 24; 68 Oct. 11—photographs TN 52 and MY 7).

It is not unusual to find two, or sometimes three, 'lone bulls' going about in close company—no doubt these are bulls from a herd staying, for the time being (which may be for 3 or 4 weeks, or a lesser period) away from the herd. In such associations the younger or smaller bull often displays a noticeably subordinate position to the big bull, and is termed his 'chela'. The most expressively overt act of such subordination is the offering of a choice twig or a sheaf of foliage, by the chela to the big bull (TN 66 Sep. 17).

Sanderson records seeing a young male calf all by itself. A 5-year-old bull calf was also seen by me, contentedly feeding by himself throughout a day—there were no other elephants around (TN 59 Apr. 1). Such solitary animals are most exceptional, and one never sees an adult cow by herself, though a cow and her grown calf were repeatedly seen grazing by themselves on a hillside, not joining the other elephants on that hill (K 70 Apr. 19, 21, May 4, 5). Only adult bulls are normally seen by themselves.

These, as Sanderson points out, are seldom 'lone bulls', but the big bulls of some herd which may be, for the time being, staying away from the herd. He doubts if there is any such thing as a true 'lone bull' and dismisses the theory of an adult bull being driven away from the herd by a stronger bull as fancy. He is largely correct in much that he says, but while it is true that few bulls, if any, are truly solitary, there are records of bulls having been seen for years on end staying by themselves, or sometimes in close association with another bull: since such animals do not wander far as elephants in herd do in their seasonal quest of food, their movements are well known to the forest-living people of the area. The question is really not one so much of fact as of terminology. If, by the term 'lone bull' is meant an animal that never, in no circumstance whatever, associates with others of its kind, Sanderson is correct and there are no 'lone bulls'. The loneliest of them will, on occasion, seek the company of a cow in season or even associate with another bull for a brief while. However, if the term 'lone bull' is applied, much more properly, to an adult male that is solitary as a rule and does not join a herd except in a transient association, there *are* lone bulls among elephants. The tusker that killed the camp elephant Shibji in the Jaldapara Sanctuary (MISC 65 Oct. 20—photograph MISC 2) was known to have been solitary for years; similarly, the bull proscribed in the Mudumalai Sanctuary as a rogue (TN 59 Mar. 6 and 21) was long known as a solitary elephant in the sanctuary, though on occasion he was accompanied by a small mukna (TN 59 Mar. 6). A big tusker with magnificent tusks and peculiarities of build that proclaimed his identity was well known as a true lone bull in the Periyar Sanctuary for over a decade, and was never seen in the company of other elephants, though elephants are seasonally common in the area (K 59 May 20, 60 Apr. 4, 70 Apr. 19—photograph K 2). Other instances of a bull living by itself for years are known. Forest-living tribals and elephant men know the distinction between such truly solitary bulls and the bulls of herds that occasionally leave the herd to be alone for some time—they call the former 'lone bull' and the latter 'the lone bull of the herd', a contradiction in terms rendered necessary by the confusing social habits of elephants! In the field notes the term 'lone bull' has been used

loosely to mean both kinds of solitary bulls, but the context will make it clear which kind was meant. True lone bulls may, on occasion, drink with a herd or stay close by a herd, or even mate with a female in a herd or in an elephant camp. Such a lone bull was seen near a herd (which included three adult tuskers) at a river, but when the animals left after drinking, the herd and the lone bull went their separate ways (TN 70 Sep. 28).

G. P. Sanderson's argument that a true lone bull is never an animal driven out of a herd but one that has chosen a solitary life of its own accord, while generally true, is not invariably so. K. Krishnamoorthy once saw, first the big tusker of a herd and later the entire herd, chasing a lone bull that had attempted to enter a herd over a long distance. A solitary bull cannot just walk into a herd and be accepted, even if he is prepared to accord priority to a larger bull already in the herd, as a matter of course. Elephants are exclusive in their intra-specific gregariousness, and may not accept a newcomer: they may; the truth is we do not at present know what prompts them to react differently on different occasions in this regard. Even among animals moving in a herd, there may be sharp antagonism between adult bulls. There was only one herd of elephants in the Palamau National Park in February 1969, in which there were two muknas, both in musth: the older and larger of the two muknas actively resented the presence of the smaller, and chased him away (B 69 Feb. 23—photograph B 16).

Fights between adult bulls may be to the death, though much more commonly they are only skirmishes. Usually such major fights are between solitary bulls (whether or not one or both of them are true lone bulls), and may be sustained over a period of days, with breaks for feeding and drinking. Obviously sexual rivalry is not the cause of action (to borrow a convenient legal term) and the fight is not for the favours of a cow—such fights, too, are known, as already reported. It is not always that two bulls in the same area engage in such combats: even where a measure of hostility is apparent between the two, one may avoid the fight (TN 70 Sep. 29, Oct. 3). Considering the fact that elephants are much given to wandering over a wide area (though solitary bulls are less given to such wandering) and the further fact that several parties, herds and individuals usually feed in the same area without disputing the territory (vide the entire field notes for April-May, 1970, Periyar Sanctuary), such fights do not appear to be motivated by territorial rights—at times, though, they appear to be so motivated. Probably they are fights in assertion of dominance, when the paths of two big bulls happen to cross: human analogies are not far to seek.

All solitary male elephants, whether or not true lone bulls, are usually considered dangerous and mis-called 'rogues'. Some of them

are belligerent towards men, some are not. It has often been said that of no wild animal are forest-living men so afraid as of the elephant, and this is quite understandable, because of the unpredictable response of chance met elephants in forests (MY 68 Oct. 15). However, few seem to realise that the aggression of elephants towards men in areas where men have invaded elephant country is almost invariably motivated by human hostility initially, or that the shooting of elephants is something that has to be done expertly, if it has to be done at all, and that the wounding of the animals may only lead to further trouble. Almost invariably a proscribed rogue (i.e., an animal that has killed a man or a few men, and which has therefore been proclaimed a rogue) carries gunshot wounds, probably received in the course of raiding a sugarcane plantation or other crops, which have suddenly sprung up in what used to be primeval forest. For some reason, gunshot wounds do not heal easily in elephants, though other animals recover from them. They are apt to form festering sores, usually maggot-ridden, that cause considerable pain and handicap the animal, and they persist even for years. The proscribed rogue I observed in the Mudumalai Sanctuary in March 1959 (TN 59 Mar. 21) still carried unhealed bullet wounds when he was shot by E. R. C. Davidar some 2 years later.

The impact on elephants of human invasions of their territory is of special interest and significance. Most other diurnal animals retreat from their homes before human invasions of the deep forests, or else turn into fugitive creatures of the night, hiding by day in cover because men are active in the forests then. The elephant is not entirely, or even almost entirely, diurnal in its activity, but it seems to be the only wild animal with a sufficient sense of territory (in the face of extra-specific intrusions into its old homes) and a sufficient resentment of being disturbed and harried by men, to turn consequentially hostile towards men. In forests where they are little disturbed, the normal reaction of elephants to near human presence is flight. A big herd I was following at a distance, with the wind blowing from the animals to me, turned round suddenly and came towards me (and the cover of tree forests) at their fastest pace, running helter-skelter over uneven open ground: a while later, what had alarmed them (by scent) came into view, a small boy of about 8 herding a buffalo cow. A tusker about to emerge from thorn bush turned back and retreated into the dense cover on hearing the sound of a man cutting wood with an axe (TN 64 Mar. 21). Many instances of the natural tendency of wild elephants to bolt from the near presence of men are on record. They are even able to associate cattle with men, and usually flee from cattle, unless they are sure that there are no herdsman with the beasts (TN 64 Mar. 21, 69 Sep. 23).

Where they have been much disturbed and harried by men, their reactions to humanity undergo a change. Flight is still the commonest reaction, but they may become more assertive and indulge in demonstrations and even in attacks. An interesting response, when elephants have to cross a road in a forest and stay close to the road to drink or feed, is to pull down a few culms of giant bamboo from a roadside clump, or a sapling, across the path and constitute a road-block (TN 66 Oct. 6 ; MY 68 Oct. 9).

In assessing these responses and aggressiveness to men, it should be remembered that elephants are longlived animals with a clear topographical comprehension of their stamping grounds and that their resentment of intrusions, such as man-made structures, into their territory, and their proclivity to destroy such structures is something that can even be anticipated (TN 59 Mar. 31). It is said that on occasion their hostility to men takes the form of flinging stones (by the trunk) at the intruders, a less wildly improbable response than it might seem to those not intimately familiar with elephants. Tame elephants sometimes demonstrate their dislike of being annoyed by picking up and throwing a stone at a man—this is something well known, and it is even common knowledge among men in elephant camps that some tame elephants are more prone to this action than others. I have personally experienced the resentment of my attempt to get close to a herd (in which there were young calves) by the leading cow of the herd getting on to a path above me and sweeping down stones and debris at me from above with her trunk (K 70 May 2—photograph K 26).

The more usual manifestation of resentment of human intrusion is a demonstration or a charge (TN 63 Sep. 19 and 20, 64 Mar. 25, 69 Sep. 20, 70 Sep. 19). However, even in an area like the Moyar block of the Mudumalai Sanctuary where what was long known as a favourite haunt of wild elephants has been invaded by a hydro-electric project, canals, clearings for the powerlines, human settlements, and agriculture and plantations, and where the human population has increased enormously and thousands of cattle are herded everyday in the forests, what is positively astonishing is not the occasional aggression of the wild elephants but their acceptance of man-made intrusions and their tolerance of humanity (photograph TN 29). Almost every year a few people are killed by elephants in and around the Mudumalai Sanctuary (the entire area, as explained in the General Account of the sanctuary in the notes for 1959, must be taken as one natural wildlife unit, though politically demarcated between three States) but these killings occur in the course of chance encounters between men and elephants inside the forests, and not at human settlements invaded by the elephants: incidentally, cows and even subadults are responsible for many of these attacks and not only